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JOHN BOURNE, C. E.

MR. JOHN BOURNE was born in 1812, at Clonard, near Dublin, a country seat of his father's—Captain Bourne, R.N. The family originally came from Lincolnshire, and most of its members were men of mark in their day, not only for their great energy, but for the self-sacrificing spirit with which they devoted themselves and their means to the promotion of what they saw was necessary and advantageous for their fellow-countrymen, that is to say, the extension and development of intercommunication both by the mail system, by improvements in postal matters, and by direct encouragement and assistance in the establishment of lines of steamers. Considering the literary proclivities of the subject of our sketch, it will not be surprising also for our readers to learn that some members of the family were distinguished by their connection with pursuits of that nature.

In 1833, Captain Bourne, the father of the subject of our sketch, in connection with some friends, constructed the "Royal Tar," the most powerful steamer of her day. She was chartered as a man of war first by Dom Pedro, and afterward by the Queen Regent of Spain, through Messrs. Wilcox & Anderson, shipping agents in London. M. Mendizabal, at that time Spanish Minister in London, pressed upon Captain Bourne the expediency of establishing a line of steamers between London and the Peninsula, and after some negotiation with the English Government, who consented to give up their own mail steamers, and to give a subsidy of £30,000 a year to Captain Bourne and his friends for carrying the mails, he consented to undertake the task. The new company, called the Peninsular Company, afterward expanded into the Peninsular and Oriental Company, affords the first example of the mails having been carried by contract at sea, and Captain Bourne was the first contractor for the performance of such a service. We have not space here to trace further the history of this company, but it is well known that the vessels with which it was started were the largest and most perfect of their day; they were almost wholly owned by Captain Bourne and his brothers, and were built under the superintendence of the subject of our present notice.

Mr. John Bourne was at first destined for the medical profession, and before he began the study of engineering he had served an apprenticeship of five years to a surgeon. In 1832, Captain Bourne, feeling that his son's assistance would be useful to him in the important undertakings in which he had been engaged, induced him to abandon medicine and begin engineering. In pursuance of this arrangement he entered the engine works of Messrs. Duffus & Co., of Aberdeen, whence, in 1833, he was transferred to the works of Messrs. Caird & Co., of Greenock. His progress was rapid. In 1834 he invented the marine governor, also an air brake applicable to coaches, to utilize the power wasted in friction when a coach descends a hill by making the wheel, by means of a cylinder and piston, to force air into a receiver, the air thus stored being employed to assist in the ascent of the next hill. This scheme has lately been revived in the air tramway vehicles in Paris. In 1836, Mr. Bourne introduced his marine governor into the steamer "Don Juan," the best and largest of the steamers then built for the Peninsular line. Into this vessel he also introduced various other improvements, of which the following were the most prominent: Starting cylinders for starting the main engines; a salinometer for indicating the density of water in the boiler; an annular steam casing round the chimney for superheating the steam; and safety valves pressed by springs instead of weights, to prevent the loss of steam from the working of the ship. In 1838 his first patent was taken out, and it forms a perfect repertory of important inventions. In it will be found the first marine tubular boiler, and it is associated with a surface condenser; also the first example of a donkey engine. The expansion valve, known generally as Meyer's, and which consists of two plates advanced or retired by a right and left hand screw, here appears for the first time—two years before Meyer's valve was invented.

One of the latest and most important of Mr. Bourne's many inventions is his method of balancing the momentum of the reciprocating parts of engines, whereby it becomes possible to work them, without shock, tremor, or other inconvenience, at a high rate of speed, by which a small engine is enabled to do the work of a large one—weight and cost being thus diminished to an extent that cannot otherwise be attained.

Mr. Bourne's high-speed engines, which embody this discovery, are already well known, and in practice have been found to give very remarkable results.

Mr. Bourne has been three times in India. In 1847 he went out as one of the engineers of the East Indian Railway, and subsequently he visited that country in connection with important enterprises in steam navigation. His literary works, by which he is most widely known, have occupied but a small portion of his time, but they still hold their place in the foremost ranks of engineering literature—no other works of equal value having since been produced—and they have a special claim to the attention of our readers from the evident "bent of Mr. Bourne's ideas toward subjects which mainly concern them. His Treatise on the Steam Engine, begun in 1844, was finished in 1846. His "Catechism of the Steam-Engine" appeared in 1848, his Treatise on the Screw Propeller in 1850, and his "Handbook of the Steam-Engine" in 1864. These works have gone through a great number of editions, and have been constantly revised and amplified since their first appearance. Of late years Mr. Bourne's attention appears to have been chiefly taken up with his high-speed engine, for which he anticipates an important future, seeing that an improved and cheapened motive power is one of the most exigent wants of the day. —*Marine Engineering News.*

J. Bourne. 1867

THE NON-PISTON AGE OF THE STEAM-ENGINE.

By WILLIAM MANN.

WE have been made acquainted with many instances in which prehistoric man employed fire for other purposes than mere comfort, but whether the *cave* man used it in any technical manner is uncertain, notwithstanding we are sure that he had knowledge of the value of this element; and, perhaps, long before the time that the fires were alight which charred the wood found under thick layers of stalagmite in Kent's Cavern, Devon, he knew that fire converted water into steam, and that, after a time, the water disappeared altogether. But whether such knowledge was of any use to our cave dweller or not we cannot hope to learn; nevertheless, as soon as we come into the domain of history, we find the priesthood of Egypt and elsewhere in full possession of this phenomenon, and turning it to account in connection with their idol worship. With steam they moved and voiced their gods, intensifying superstition and trading upon ignorance.

We need not trouble to inquire when the bursting force of steam was first recognized, seeing that as far back as information reaches as to the early notions entertained concerning the cause of earthquakes the disruption of the ground was attributed to the power of pent-up steam beneath, generated by subterranean fires; hence it would be natural to regard it as an element of great power, and, if controlled, of much usefulness. This idea is necessarily an old one, and by degrees, no doubt, led to the application of steam in the manner we are about to mention.

As our intention is only to mention the invention or suggestion of engines for raising water by steam, without the intervention of a piston, we shall pass over all the mere steam toys, from that devised by Hero, who flourished about 2,000 years ago, and come at once to De Caus, a scientific Frenchman, who published a book in 1615, in which mention was made of an apparatus for driving water up a tube by the aid of fire. This little affair is illustrated in Fig. 1 (see next page), and may be thus explained:

Nearly fill the vessel with water through the funnel, and light a fire underneath. As soon as the water reaches the boiling-point, the pressure of the steam produced sends the water up the tube in the form of a fountain, or rather a frightfully spluttering, hissing jet of steam and water, neither ornamental nor useful.

There seems to have been a great deal of controversy respecting the doings of this distinguished mathematician and engineer, and the question has often been asked, How could M. Arago assign any part in the invention of the steam-engine to De Caus? Well, it is to be supposed, because he was a Frenchman, and did really give a description of a something that would send water up a pipe by the agency of fire.

Forty-eight years after De Caus published his work—that is, in 1663—the Marquis of Worcester produced, in manuscript, his "Century of Inventions." One of the inventions set forth in this document, we are told, is clearly an engine for raising water by fire, or steam; therefore, Professor Robinson affirms "that the steam-engine, the greatest discovery of modern times, was, beyond all doubt, invented by the Marquis of Worcester." Let us see to what extent the description of the invention confirms this. He says:

"An admirable and most forcible way to drive up water by fire, not by drawing or sucking it upwards, for that must be, as the philosopher called it, *infra sphæram activitatis*, which is but at such a distance. But this way has no bounder if the vessels be strong enough; so that, having a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream 40 feet high; one vessel of water, rarefied by fire, driving up 40 of cold water. And a man that tends the work has but to turn two cocks that one vessel of water being consumed, another to force and refill with cold water, and so successively, the fire being tended and kept constant, which the selfsame person may likewise abundantly perform in the interim between the necessity of turning the said cocks."

In the above quotation we have intentionally omitted a portion of the original for the purpose of comparison, or to show, if nothing else, how often two minds travel in the same direction when in the pursuit of the same object.

Although De Caus evidently had a confused notion with respect to what actually took place when water in a confined state was subjected to the influence of fire, he was quite clear as to the result of such treatment. He says: "The violence will be great when water exhales in air by means of fire, and that the said air is enclosed; as, for example, take a ball of copper, one or two feet in diameter and one inch thick, which being filled with water by a small hole, afterwards strongly stopped with a peg, so that neither air nor water can escape; it is certain that if we put the said ball upon a grate fire, so that it will become very hot, that it will cause a compression so violent, that the ball will burst in pieces with a noise like a petard." The Marquis also, to illustrate the great power exerted by water when in a confined space and under the influence of fire, says: "I have taken a piece of a whole cannon, whereof the end was burst, and filled it three-quarters full of water, stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it; within twenty-four hours it burst, and made a great crack."

Now as to what these two men have done to be considered the inventors of the steam-engine. The first in order of time wrote as if he knew that a great power was developed by subjecting water in a closed vessel to the action of fire, and also showed plainly how, under certain conditions, water could be forced by this means up a pipe; although at the same time there appeared to be some obscurity as regards the precise change that took place by this application of heat to water; nevertheless he knew that fire "caused a compression so violent" as to burst the vessel in which water was confined; and he knew also that if a pipe were inserted that had reached near to the bottom instead of a "peg," the water would be driven up it while any remained, instead of the vessel bursting in "pieces with a noise like a petard."

The second, with the light of half a century later, and perhaps the glimmer of De Caus's book added to it, recognizes the fact that water was converted into *steam* by fire, and that by its aid large quantities of water could be raised to great heights, and "with little change made to drain all sorts of mines, and furnish cities with water, though never so high seated, as well to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for private occasions," and so on, with an immense amount of verbiage, with which alone we are left.

Of course the Marquis has always had his admirers, the fact of his being a marquis no doubt in part accounting for this. While some of our most ingenious men have worked hard to invent a something that should in some degree comply with his statements, no other form of information has been supplied to us; but all have given it up as impossible without some mechanical interpolation of their own or of their time. It is evident that the tendency on the part of the Marquis to make statements without having devised any means to carry out his theories in practice was without "bounder." Note this—the strengthening of his "vessels by the force within," and imagine any person seriously setting to work to contrive or produce a vessel the parts of which, under strain, recede from the point of rupture as the force to rupture is increased. Yet we find in Galloway's "History of the Steam-Engine" the following:—"The strength-

ening of a vessel by the force within also appears to be a mechanical impossibility; but we conceive that, to an extent equal to any force required for raising water, a boiler, of the form represented in the figure, would be strengthened by the internal pressure." Suppose a boiler "composed of arched iron plates, with their convex sides turned inwards; they are fastened at their joinings by bolts passing through holes in their sides, which also pass through the ends of rods, a series of which extend from end to end of the boiler, being a few inches apart." The ends of this boiler are hemispherical, and fastened to flanges of the plates

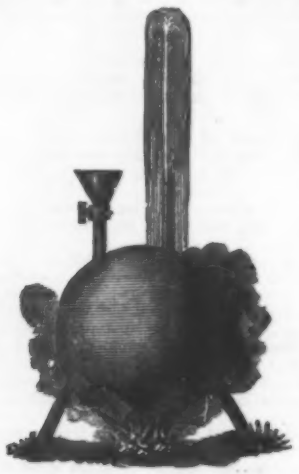


Fig. 1.—DE CAUS'S STEAM PUMP, A. D. 1615.

forming the top, bottom, and sides of the boiler. "It will appear evident that, each plate being an arch, before the boiler can burst, several if not nearly all the rods must either be pulled asunder or torn from the bolts at the points of junction; and as the strength of the rods and bolts may be increased to any extent, without interrupting the action of the fire, there can be no doubt but that a boiler might be so constructed as to be perfectly safe under any pressure which could be required for the raising of water to a given height, because the pressure in such a boiler will never exceed the weight of a column of water equal in height to the elevation of the cistern." Did any one ever see such an interpretation of an obscure passage in connection with secular matters? which, if it means anything, means what it says, and that is this, that the Marquis of Worcester had "found out a way to make his vessels so *that they* were *strengthened* by the *force within them*."

What we have quoted simply tells us that a boiler, if made strong enough for its work, will not burst because of its load; it does not tell us how to make one that grows in strength as the force to burst increases. This is what the Marquis wanted his readers to believe.

Again, after Professor Millington and Mr. Stewart had spent a great deal of time in devising two ideal engines (see drawing, Fig. 2; description given below), Mr. Stewart was compelled to observe, with regard to the part that they had endeavored to interpret, "that from the opinion we have expressed of its being practically impossible to produce an apparatus fulfilling *all* the conditions of the description in the 'Century of Inventions,' without introducing parts which are unquestionably due to the inventive genius of other mechanics, it is with great diffidence we propose the apparatus represented." But, after all, it is impossible to decide, from Lord Worcester's description, whether *two* boilers are meant and one receiving vessel, or two vessels and one boiler, or only two vessels, like De Caus's, probably having each an eduction-pipe and proper cocks to produce continuity in the stream of water, as in the figure, where the dotted lines rising from the vessel *a* would then represent this pipe, the fire being made under each boiler alternately.

And where mention is made of one vessel of water, rarefied by fire, driving up 40 of cold water, should not this be understood as the proportion of water which would be converted into steam, in order to raise the remaining portion in the *same vessel* 40 feet high?

An apparatus designed on this supposition would satisfy the description nearer than any. Having so wide a choice, we will give the Marquis credit for an apparatus for generating the steam in a separate boiler; *a* will, therefore, be that boiler; *c*, a pipe (having a stopcock, *d*) connecting the boiler with the cold water vessel, *e*, from which proceeds the eduction-pipe, *f*; *g*, a pipe and funnel to supply the boiler with water; *h*, a similar pipe to supply the vessel, *e*, with cold water, connected with a cistern from which the water is to be raised; *i* is a stopcock to this pipe; *k*, a valve to prevent the return of the water which may be in the upper part of the pipe, *f*.

When the steam in the boiler, *a*, is allowed to enter the cold water vessel, *e*, by turning the cock, *d*, the water is raised in a jet through *f*, until the vessel, *e*, is emptied. When this is the case, the cock, *d*, is shut, and *i* is opened, and the vessel, *e*, is again filled with cold water. The cock, *i*, is then shut, and the stopcock, *d*, is opened; and the steam from the boiler, pressing on the surface of the water in *e*, forces it up the pipe, *f*. When this is emptied, the same operation is repeated, and so on successively; so that the condition of the alternate opening and shutting of *two cocks* is fulfilled; also the forcing and refilling of the vessels; and one vessel of water rarefied by fire would elevate double the quantity of that stated by the Marquis.

Now, all this guessing, forcing of the text, and scheming was resorted to to get, if possible, something out of the writings of a man of whom it is said, after noting a few of his sayings and doings, some of which will "hold water" and some will not, that "his fame must ever rest and grow in importance, through the fact of his being the inventor of the steam-engine in its primitive form as a 'water-commanding' or 'fire' engine." Where is the proof?

About 1684 Dr. Papin, a scientific Frenchman, while trying the effect of high-pressure steam on animal substances, for the safety of his apparatus introduced the safety-valve. At a later date, and before the date of Savery's patent, he had suggested that a vacuum could be formed under a piston by vaporizing a small quantity of water beneath it, and then, by condensing the same, obtain power from the pressure of the atmosphere. This idea was not pursued to any useful purpose, his mind having been diverted by the invention of Savery, for which he suggested improvements that will be mentioned in the order of date.

Captain Savery was, no doubt, a practical miner. The term "captain" indicates a leading hand in this business, and, therefore, he was well qualified to catch certain ideas that were floating about in his day, and put them into a practical shape for the all-important object of raising water from mines. Of course he had to take the boilers as he could get them, but the safety-valve was already an efficient

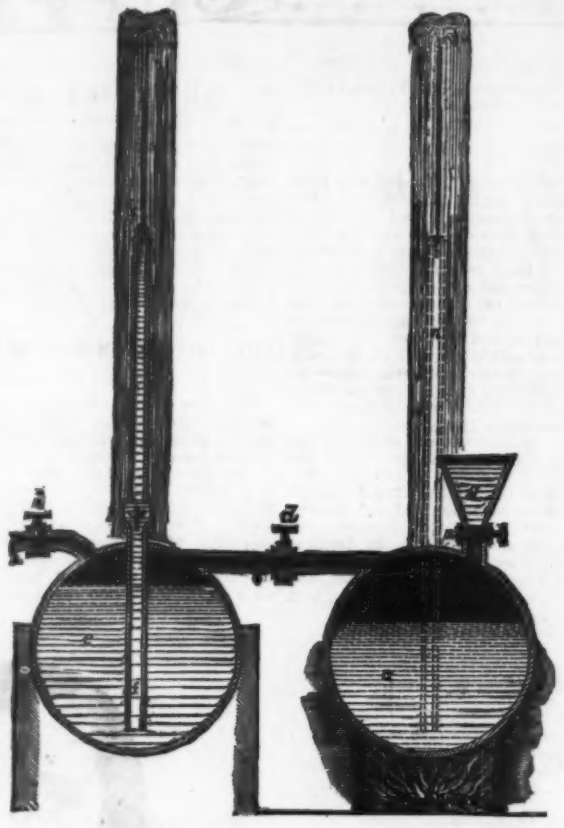


Fig. 2.—THE MARQUIS OF WORCESTER'S STEAM PUMP, A. D. 1623.

appendage, but for which very little could have been done at all with steam.

Fig. 3 is an illustration of the engine in its most primitive condition. The engines, in practice, were arranged according to circumstances, which were various; therefore, to give the earlier conception will be all that is required in such a paper as this. Savery's instructions were as follows:—"Before you make any fire, unscrew *g* and *n*, being the two or small *gauge-pipes* and cocks belonging to the two boilers, and at the holes fill *e*, the large boiler, two-thirds full of water, and *d*, the small boiler, quite full. Then screw on the said pipes again. Light the fire at *b*, and when the water in *l* boils, open the cock of the first vessel, *p* (shown in section), which makes all the steam rising from the water in *l* pass with irresistible force through *o* into *p*, pushing out all the air before it through the clack, *r*; and when all is gone out, the bottom of the vessel, *p*, will be very hot; then shut the cock of the pipe of this vessel, and open the cock of the other vessel, *p*, until that vessel has discharged its air through the clack, *r*, cylinder refills with water through the clack at the bottom of *i*; and when the float has risen to its proper position, the steam is again admitted as before.

The idea of covering the surface of the water was good, but the greater evil—that is, the cold surface of the cylinder—still remained untouched; in fact, this great source of waste existed in all forms of condensing engines, especially those of the non-piston type, until Watt's condenser was presented to the world.

In 1819, Mr. John Pontifex, of London, took out a patent—one hardly knows why—for improvements on Savery's engine, which had long gone to its rest. But it would have been an improvement on all engines of that sort, had any existed, and therefore we shall introduce it as we proceed to explain a resuscitation of that class, called the pulsometer:

Pontifex's Water-Raising Engine.

The engravings, Figs. 5 and 6 (see next page), show the water-raising engine described in Pontifex's patent, in which

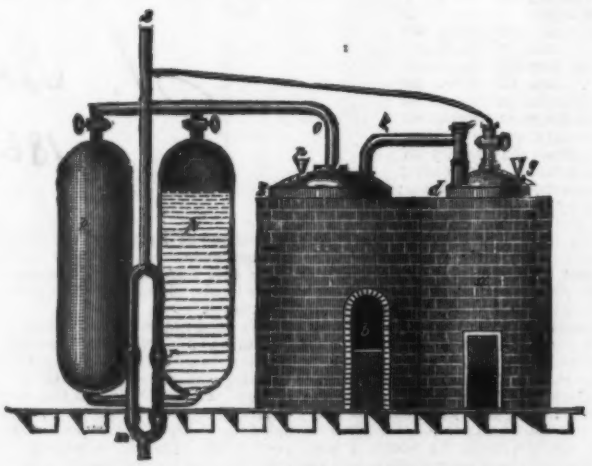


Fig. 3.—SAVERY'S STEAM PUMP, AFTER A. D. 1684.

up the force-pipe, *s*. In the meantime, by the *steam condensing* in the vessel, *p*, a vacuum or emptiness is created, so that the water from the well must and will necessarily rise up through the sucking-pipe, *t*, lifting up the clack, *m*, and filling the vessel, *p*. In the meantime, the first vessel, *p*, being emptied of air and filled with water, open the cock again, and the force is upon the surface of the water, and presses with an elastic quality, like air, still increasing in elasticity or spring till it counterpoises, or rather exceeds, the weight of the water ascending in the pipe, *s*," or rising main, as now called.

We now come to the suggested improvement on Savery's engine by Dr. Papin in 1707, of which Fig. 4 (see next page) shows a section; *a* is the steam-pipe communicating with *b b* are two steam cylinders, connected by cross tubes at *c c*, in each of which a vacuum is alternately formed by the condensation of elastic vapor, conducted from the boiler by the bent tube, *d*, and admitted to the steam cylinders by means of the slide-valve, *e*. *f f* are two tubes perforated with small holes for the admission of steam and injection water, the latter of which is distributed by falling on the strap, *g*. *h* is the suction-pipe, proceeding nearly to the bottom of the well, which in no case ought to exceed from 28 to 30 feet in depth, so that, a vacuum being formed in the copper vessels, *b b*, the water will be raised by the pressure of the atmosphere, and passing up the tube, *h*, will take the place of the elastic vapor. *i i* are two valves placed at the upper end of the suction-pipe, *h*, which allow the upward passage of the

water from the well, but prevent its return. *j j* are two similar valves opening into the air vessel, *k*, to which is attached the nozzle, *l*, serving to convey the water from the copper cylinders to any required point; *m*, the injection-tube, furnished with a valve, and intended to convey water from the box, *n*, to the taper tubes, *f f*; *p*, stop-cock to regulate the supply of condensing water. There is a tube passing from the bottom of the cistern, *n*, to the injection-tube, *m*, and furnished with a stopcock at *s*. To put this engine in action, one of the buckets must now be made to descend, which will open the slide-valve, *e*, and admit the steam into the right-hand cylinder, *b*. The atmospheric air, which will thus be expelled from the cylinder, is allowed to pass through the valve, *j*, and nozzle, *l*. The other bucket must then be depressed, and by this action on the slide-valve it will open a communication for injection water through the pipe, *c c*, which water, passing down the perforated tube, *f*, will immediately condense the steam, and form a vacuum in the

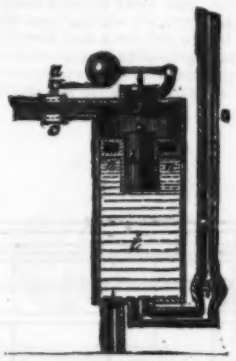


FIG. 4.—PAPIN'S IMPROVEMENT ON SAVERY'S ENGINE, A. D. 1707.

vessel. The whole pressure of the atmosphere being now removed from the suction-pipe, *h*, the water will rush up to restore the equilibrium, and, the vessel, *b*, being filled, will furnish a supply at the bent tube, *l*. Having examined the action of one half of the apparatus, we may suppose the same effect to be produced on the opposite side. The steam will, in the first instance, be admitted by the pipe, *c*, and a communication afterward opened by means of the slide-valve with the condensing water, which, by condensing the steam, will form a vacuum, and the water will again ascend as in the first vessel. The stopcock, *y*, must now be opened, and the bucket, *x* (first described), made to descend, which will restore the slide-valve, *e*, to its original position, and, admitting the steam to the upper part of the first vessel, will depress the water, and cause it to flow through the valve, *j*,

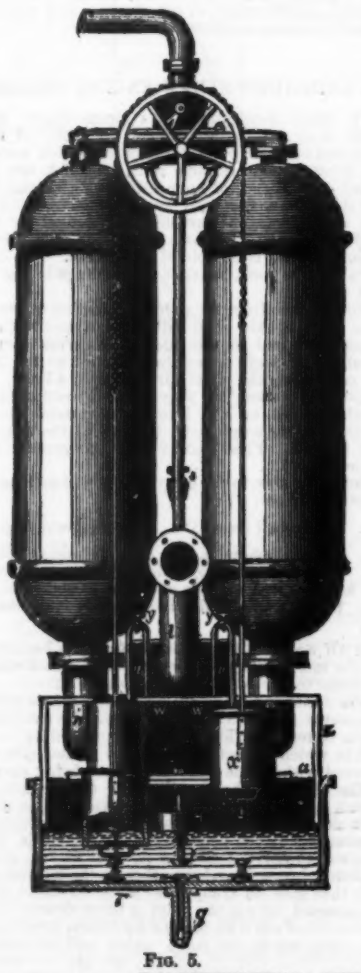


FIG. 5.

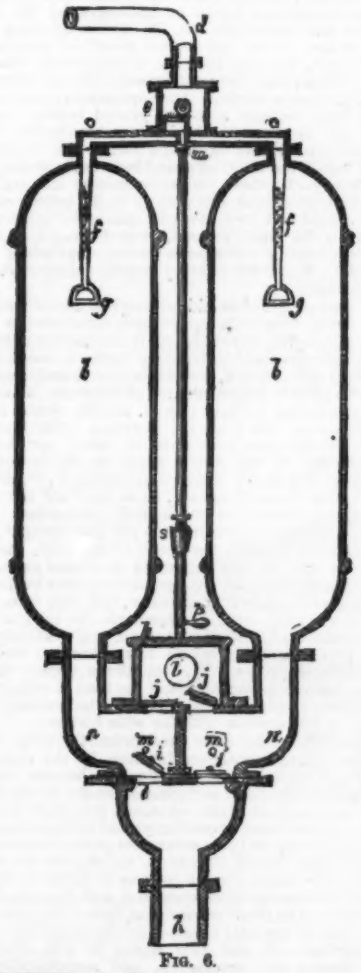


FIG. 6.

PONTIFEX'S STEAM PUMP, A. D. 1819.

and nozzle, *l*, while at the same time water will pass through the tube, *u u*, in which the valve, *w*, is inserted, beneath the inverted vessel, *v*. The water will continue to enter the bucket, *x*, till its increasing weight causes it to preponderate, and turn the slide-valve, *e*, in the opposite direction. Should there not be a sufficient supply of water in the cistern, *r*, for the purpose of condensing the steam in the larger vessels, the stopcock, *p*, must be opened, and an additional supply of water will then be furnished from the chambers, *n n*, by the tube, *m*; and, in the event of the bucket not being depressed at the instant that the water is expelled from the chamber, *n*, of the vessel, *b*, the steam will pass through the tube, *u u*, and act between the under side of the fixed inverted vessel, *v*, and the surface of the water in the movable bucket, *x*, the descent of the bucket being accelerated by the repellent force of the steam, so that by the alternate action of the buckets, *x x*, the motion of the engine is rendered continuous.

THE AMERICAN PULSOMETER. HENRY C. HALL, OF AMERICA.

This seems to be a strange name for what is, after all, only a rough-and-ready steam-pump, an implement by which so many gallons of water per hour are raised by the consumption of an ungiven quantity of fuel. Notwithstanding, as it possesses some unusual properties, it is worth while to understand them.

The engraving, Fig. 7, exhibits a vertical section of the pulsometer, taken through the center of the water-chamber. It will be seen that the pear-shaped body of the apparatus is internally divided into two chambers, A A, separated by a vertical partition extending laterally on each side of the upper part, where it forms an elliptical air-chamber, B, one side of the diaphragm communicating with the delivery and the other with the suction. C is the induction passage for the passage of the fluid to be raised, opening out on either side into the chambers, A A, and fitted with valves, E E. D is the discharge, the chamber of which is provided with two valves, F F. Guards, G G, control the valves, E E, as to their degree of aperture, and the openings at the lower part of the chamber are closed by covers, H H. The chambers, A A, are surmounted by a neck, J, bolted thereto, and the two passages of the chambers open into a steam chamber, in which a ball-valve, I, is fitted, capable of oscillating between the duplex valve-seats formed at the junction. The cylinder and air-chamber are furnished with air-cocks. The pipe, K, is for the admission of the steam, which passes down that side of the neck left open by the position of the valve, I. Entering the chamber, the steam presses on the surface of the contained liquid, which is driven out on the opposite side, through the discharge opening, D, into the rising main.

But what of the claims of this remarkable pump? The inventors tell us that it "can never be worn out." This, of course, is only a joke, and not intended to mislead; for, printed with the pulsometer price list, we get a catalogue of all the renewable parts, and the cost thereof, just as from the pump makers who do not pretend to supply indestructible apparatus. It "will pump almost anything." This is good. It is to be wished that the venders could also say, after the manner of the Marquis of Worcester, that it is "an engine so contrived" that it will in an incredibly short space of time so "pump" the Thames Conservancy and Metropolitan Board of Works as to ascertain their motives with regard to the drowned-out dwellers by the Thames, and so helm them that "their forward or backward, upward or downward, circularly or otherwise, to-and-fro, straight, upright or downright tendence do not hinder, much less stop, not be claimed as new, for practice shows us that this maxim has been held by the users of steam power from its birth, and is likely to continue until the law declares that a man is not fit even to look after a pulsometer (at all events until it has received one more improvement, and is able to do without a boiler altogether) who would hang a heavy coat to dry on the end of a safety-valve lever, and think nothing of it; much less one who would wedge down the valve to get rid of the noise of the steam blowing off.

FIG. 7.

If boilers are not false witnesses, they may be said to have proclaimed aloud, times without number, to the inhabitants of surrounding neighborhoods, that the absence of skilled attendance is present with them as palpably as the *débris* of explosions; therefore, we may fairly object to this unhonored practice being considered as novel.

Another claim should be noticed, because it is not the cheapest thing that is at all times the most profitable. It "is cheaper than any other pump." This, of course, means that its first cost is less than any other pump of equal water-raising power. That may be, but there is something else to be considered besides this. In the matter of steam power there is that every-day demand in the shape of fuel, of which we hear nothing in the shape of comparison with steam-pumps of the piston type. Let it not be said that comparisons are not made, because it is stated that "a comparison of our price list with those of other makers will show that it is cheaper than any other pump"—cheaper to purchase.

This matter of fuel is referred to rather indirectly by comparison with Savery's engine of 179 years ago, the force of which we cannot see, if it be not intended merely to show that the superiority of the one over the other is due to the mechanical advantages of the present day compared with those of Savery's time. Savery said, "I will raise you water 500 or 1,000 feet high, could you find us a way to procure strength enough for such an immense weight as a pillar of water of that height; but my engine, at 60, 70, or 80 feet, raises a full bore of water with much ease." Hall says that "the only way in which deep mines could be drained by Savery's engine was to erect a series of engines vertically one above the other, usually at a distance of some 60 to 90 feet." Other drawbacks, not found in the pulsometer, were naturally experienced in the use of this early type of water-engine. (1) It was needful, in the then state of mechanical science, to place the boiler near the engine, and both were necessarily fixtures, so that if the water rose some 20 or 30 feet in the mine, the boiler and engine were drowned out. (2) The expense of fuel was excessive, in consequence, first, of the loss by contact of a large area of steam with the water all through each stroke; and, secondly, of the extravagant method of effecting condensation by a shower of water alternately directed upon each vessel.

From this we have a right to infer, if we had no other knowledge to guide us, that much loss of steam comes of the contact with cold surfaces, and although for other reasons the water-chambers of the pulsometer are made of a peculiar shape, the cooling mischief is not got rid of by Mr. Hall, the patentee of the instrument, notwithstanding innumerable experiments. Take it that 50 gallons of water are to be raised at each stroke, there must, of course, be a vessel capable of holding that quantity, the internal surface of which must be equal to a certain area, and to this area as the water is expelled will the steam be gradually and ultimately exposed, and as water takes heat very slowly when applied to its surface, the cooling area of the water compared with the metallic, which is a good conductor of heat, is hardly worth naming.

The water having been expelled, the chamber is full of steam, which must be speedily condensed, that one vessel may again fill with water while the other is being discharged, and so on. It was, and still is, important that these operations keep time, in order to get a full and efficient stroke at each alternation. Savery's engine being manual, his remarks respecting this are worth quoting: "On the outside of the vessel you may see how the water goes out as well as if the vessel were transparent; for as far as the steam continues within the vessel, so far is the vessel dry without, and so very hot as scarce to endure the least touch of the hand. But as far as the water is, the said vessel will be cold and wet where any water has fallen on it, which cold and moisture vanish as fast as the steam in its descent takes the place of the water; but if you force all the water out, the steam or small part thereof going through will rattle the clack" (the valve in the rising main), "so as to give sufficient notice to change the cocks, and the steam will then begin to force upon the other vessel without the

"semi-omnipotent engine, and do intend that a model thereof be buried with us."—(*Century of Inventions.* Emended translation.) The "semi" spoils the whole affair. No power that will admit of this prefix can bring about such a joyful consummation; consequently, we must return to the pulsometer as we find it.

The statement that it "needs no skilled attendance" can-

least alteration in the steam" (as regards pressure), "only sometimes the stream of water will be stronger than before, if you change the cocks before any considerable quantity of steam had gone up the clack; but it is better to let none of the steam go off, for that is losing so much strength" (so much fuel), "and is easily prevented by altering the cocks some little time before the vessel is emptied."

The equivalent to "altering the cocks some little time before the vessel is emptied" was ingeniously provided for by Mr. John Pontifex, in an engine constructed soon after his patent (1819) for "Improvements on Savery's Engine," and erected at the City of London Gas Company's works, Dorset street, Blackfriars. The remains of this engine were preserved by the writer until within a short time of the amalgamation of the company with the Chartered Gas Company, and the consequent abandonment of the site for gas manufacture.

It will be seen, by a reference to the engraving, that for the same purpose (the injection excepted) for which the "steam-ball" is employed in the pulsometer, Pontifex supplied a slide-valve, actuated by a simple self-acting arrangement, which may be thus explained: Connected with the valve-gear were two small buckets, one to each water-cylinder, into which alternately a small stream of water could flow. Each bucket contained, when nearly full, a weight of water sufficient to shift the valve. At a point near the bottom of each cylinder, and, consequently, near the end of each discharge or stroke, was an orifice, to which was fixed on the outside a small pipe, bent at the end and looking downward, to which was screwed an inverted vessel that fitted into each bucket when up to the point where the water was received, like a cover, with a deep rim that reached nearly to the bottom of the said bucket, for a purpose to be described. Suppose one of the buckets to be in this situation, and the cylinder to which the bent pipe and cover are attached full of water, the slide-valve will be in the position to admit steam, therefore the outflow of the water will immediately commence through the pipe connecting the cylinder with the rising main, and a little time before the cylinder is empty, the bucket, having received its required weight of water from the said cylinder through the small pipe fixed thereto, descends and shifts the slide-valve; the other cylinder, having filled by reason of the vacuum formed therein, follows the same routine.

The object of the inverted vessel being within the bucket when up to the "bent" pipe was that if the water should be expelled down to this pipe before the bucket had received water enough to start the slide-valve, a dash of steam through this pipe, on to the surface of the water under cover of this inverted vessel, would give the valve the start, causing it to become immediately reversed, and preventing the chance of steam "going up the clack."

The steam in the Pontifex engine we have seen was condensed by injection, therefore could only be used for pumping water. It could not have been used for pumping gas tar or ammoniacal liquor, for the tar distiller does not want water mixed with his tar, nor does the gas manager want water, especially hot water, added to his liquor to *reduce* its strength. Although the steam in the pulsometer is not condensed by injection, but rather by absorption, yet the volume used to lift or pass on the water or other fluid must be condensed, as well as the steam that "blows through with a certain amount of violence," and the resulting condensement mingled with what is being pumped. It is manifest that Savery and Pontifex's aim was to *use* no more steam than was necessary to discharge their cylinders, and to *lose* no more than was due to contact with cold surfaces. For this reason, therefore, Savery shut in the steam and applied water to the exterior of the vessel, while Pontifex, with more light and mechanical skill at his command, applied the water for the condensation of the steam to the interior of his cylinders. Both men were clearly working to prevent the sort of indefinite loss due to blowing through to the rising main, and to form their vacuums by condensing the steam, and only that portion of it which was left after the fluid had been expelled.

This brings us to show how the vacuum is produced in the chambers of the pulsometer, and here it must be confessed that there seems to exist a sort of hap-hazardness about the operation. It is said that "the moment the level of the water is as low as the orifice which leads to the discharge, the steam blows through with a certain amount of violence" (violence is the right word), "and being brought into intimate contact with the water, *an instantaneous condensation takes place*, and a vacuum is in consequence so rapidly formed in the just emptied chamber that the steam-ball is pulled over into the seat opposite to that which it had occupied during the emptying of the chamber, closing its upper orifice and preventing the further admission of steam, allowing the vacuum to be completed." This is not clear. It is difficult to understand how "a vacuum is rapidly formed in the just emptied chamber," while the steam is rushing through full bore, nor how the ball will leave the seat of the filling chamber "until that chamber is full and the vacuum gone. It would seem that the vacuum can only be formed after the ball has changed its place. It has before been remarked that it is claimed for the pulsometer that it will pump almost anything. In a sense this may be admitted; and, no doubt, while employed in pumping water, it can be brought to a fair condition of *heat* by the use of the steam-regulating valve and air-cocks. This condition gives the maximum of work with the minimum of fuel, whatever that may be. Any one who has paid attention to the principle of the pulsometer's action will have noticed that it is due to the formation of a vacuum within the body of the pump itself, and not in a separate vessel, consequently water cannot always be used for that purpose, as in the condensing steam-engine, and, therefore, however unsuitable the fluid passing through the pump may be for forming a vacuum, it must be accepted, as no other can take its place. There is a difference, however, between the condensing engine and the pulsometer, with regard to the mode by which the steam and water, or other fluid, are brought into contact. In the first, water is injected into the steam; in the second, the steam is injected into the water or other fluid, and should the fluid be such as to form the vacuum slowly (as with oils or tars), the pumping will be slow, and more steam lost by blowing through. The gas-works product—ammoniacal liquor—would, no doubt, work the pulsometer as well as water; but whether the liquor would bear the steam and hot water treatment without much injury is a matter to be considered in connection with this pump and this product.—*Journal of Gas Lighting.*

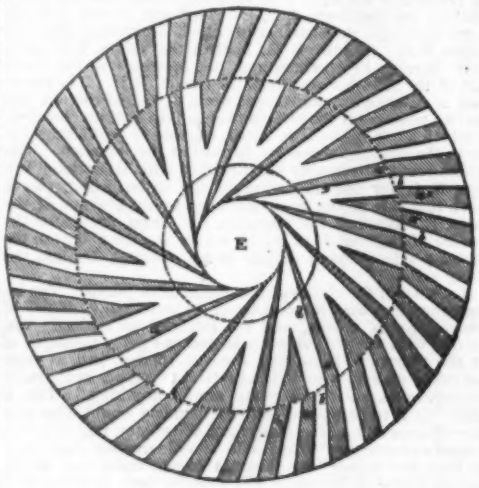
Bluing Iron and Steel by Boiling.—If iron or steel articles be boiled in the following mixture they will take a fine blue tint: Dissolve 4 ozs. hyposulphite of soda in 1½ pint of water, and then add a solution of 1 oz. acetate of lead in 1 oz. of water.

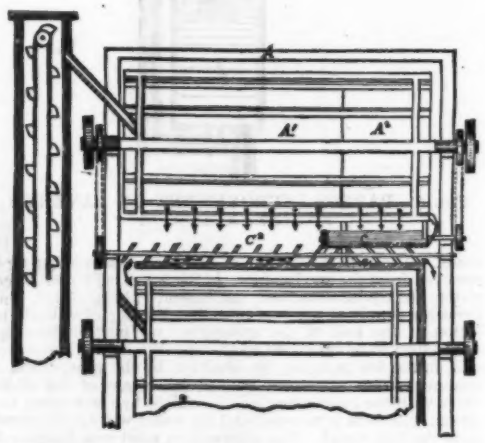
JONES' NEW PROCESS.

The furor produced among millers in some parts of the country, more especially in Lancashire and the north, with reference to Jones' new process of flour manufacture, has been noticed in *The Miller*. Being secret, the question, What could the process consist of? naturally excited much inquiry, which, being of a fairly legitimate character, we have the satisfaction of being able to answer it, so far as the means of so doing are given in the records of the Patent Office.

The process is the subject of a patent, No. 1670, dated 30th April, 1877, a communication from Mr. Thomas Jones, U. S., the patentee being Mr. H. J. Haddan, and it has reference to "Improvements in milling and in the machinery therefor." Our illustrations of the millstone dress and flour-dressing reels, are reproduced from the drawings lodged in the Patent Office, with the complete specification; and in order that our readers may have means of estimating for themselves the practical merits of the process, we quote, without remark of our own or variation from the text of the document, the complete specification itself:—

This invention relates to the preliminary treatment of grain, preparatory to the final manufacture of the same into flour, the object being to improve the color and general quality of the flour; and the invention consists essentially in the following process and means of disintegrating the offal from the flour and middlings, viz. by first subjecting the grain to the action of two hereinafter described peculiarly dressed millstones, whereby the offal is completely cleaned of all flour-yielding properties, and consequently an increased amount of middlings is obtained at one operation; thence passing the grindings through a reel of graded bolting cloth, constructed and operated in the manner hereinafter fully described, and constituting likewise a part of the invention by means of which the flour, offal and bran are successively separated from each other, and subsequently the bran is intermixed with pure flour, preparatory to the bolting of the same in the graded reel, to prevent its adherence to the bolting cloth during the latter process, thus freeing the flour from all deteriorating substances before regrinding the same, whereby a whiter and in every respect superior quality of flour is obtained.





JONES' NEW PROCESS FOR MILLING.

The first part of the aforesaid process is accomplished by the peculiar dress of the millstones, clearly illustrated in Fig. 1 of the accompanying drawing, and it consists principally in providing the stone with a centrally inclined, concentric, circumferential depression, *d*, around the eye, E, and comprising one-fourth more or less of the area of the stone. *a*, a^1, a^2, represent the grinding surfaces proper, usually termed lands of the millstones, and *b* are the furrows. The area of the stone is divided into a number of lands, as shown, some terminating in one acute angle at the eye of the stone; these, as well as the intermediate lands, a^1, a^2, diminish in width from the curb inward, so as to allow the offal to be completely cleaned of its flouring properties. The furrows are arranged at such relative pitch or draught, and gradually widened towards the center of the stone, that the outer lands, a^1 and a^2, are caused to terminate as shown. The adjacent surfaces of the contiguous stone may be formed with a corresponding central depression, and thus form with the same an outward wedging receptacle for the grain, in which it is granulated, instead of ground, and gradually disintegrated from the offal before it reaches the lands or grinding surfaces proper. The middlings escape thence through the furrows to the curb, and the bran is completely cleaned by the whipping action created by the beveled grinding surfaces in conjunction with the wide furrows.

Ordinary millstones have the land proportionately larger than the furrows, and consequently cause, by the increased friction of said surfaces, the grindings to become heated. Since this impairs the color and general quality of the flour, various devices, such as blasts, exhausts, etc., have been resorted to for the purpose of ventilating and cooling the same; but since the furrows in these stone were proportionately too small, it has been found difficult to accomplish the object sought. By this invention the ingress of the air at the eye is enlarged by the central depression *d*, and the area of the furrow surfaces is so predominant over that of the land as to give free vent to the air; besides this the proximity of the adjacent surfaces of the two stones is less, and thus further facilitates the ventilation, and accomplishes the desired object. For the purpose of preventing gumming and glazing of the surfaces of the stone, and maintaining the natural grit of the same, and thus promoting the operation of the invention, I apply to the whole surface of the stone an ingredient, consisting of diamond quartz, or corundum, in sufficient quantity to cover the lands and furrows, which completely obviates the said deteriorating effects upon the stone.

The second part of the invention, consisting of the before-described process, is accomplished by the reel of graded bolting cloth, illustrated in Fig. 2 of the drawing, in which A represents the reel provided with graded cloth, the first and greater portion, A^1, of this cloth graded so as to expel all the flour, and the second and smaller portion, A^2, of such, so graded as to emit the offal, the bran escaping at the end of the reel, as indicated by an arrow, and thence either passed direct to a worm or incased conveyor, C, or through an interposed bran duster. The worm, C, is located underneath the reel inside the conveyor, C^1, and is of proper length to convey the bran to the flour conveyor, C^2, where it becomes intermixed with the flour, and carried with the same to the graded flour bolt, to be rebolted. By this intermixing of the pure bran with the flour, the adhesion of the flour to the bolting cloth is prevented, and the color of the flour materially improved, producing a clear article. I claim—

1. The process of treating grain and flour by means of millstones specially dressed, for the purposes and in the same manner substantially as herein set forth and described.

2. Preserving the natural grit of millstones and preventing glazing by using diamond quartz or corundum on the face and furrows of said stones, whereby dentations are formed therein, and their surfaces rendered granulated and of a porcelain nature, for the purposes and in the manner substantially as herein set forth and described.

3. Treating grain grindings by graded bolting cloth specially constructed and operated for the purposes and in the manner substantially as herein set forth and described.

4. The mode of dressing stones, and the machinery herein set forth and described, or other modes and machinery substantially analogous thereto.—*The Miller.*

ANDRADE'S STEAM ENGINE GOVERNOR.

We annex illustrations of a steam engine governor recently designed by M. Michel Andrade, of Paris. It is composed of three parts, the first of which consists of the ball levers or suspending rods, to which the balls are attached; the second, of connecting arms, arranged as shown; and third, of a weighted lever connected with the sleeve. The upper point of the diamond formed by the arms is fixed or centered on the axis of the governor or regulator, and the lower point is capable of movement. The other two or lateral points work in slots or openings in the suspending rods.

The distance from the point of junction of the suspending arms on the axis or spindle of the governor or regulator should be equal to the sides of the arms forming the diamond. The sleeve or weight is applied to the lower point, and can be worked either directly or by a lever.

Speed is varied by varying the position of a counter-weight placed on the lever, or a variable counterbalance weight may be employed. Instead of the weight, a spring may be used. Figs. 1 and 2 show the general arrangement of the governor.

Referring now to the diagrams, it will be seen that the apparatus consists:

1. Of two ball levers O L, O L′ (diagram, Fig. 3).

2. Of the diamond *a*, *c*, *b*, *c′*. The upper point *a* is fixed, and the lower point *b*, which is subject to movement on the axis or spindle of the governor or regulator. The other two points work or slide in slots in the suspending rods *o c*, *o c′*.

3. Of a weight P′ applied to the apex *b* either directly or by the intermediary of a lever *o′* K′. The distance *o a* must be equal to the sides of the diamond.

The following is the author's reasoning to show that this apparatus is practically isochronal. Let an imaginary governor or regulator identical to the preceding be considered, but in which the action of gravity on the balls would be destroyed without the centrifugal force being altered.

The diagram, Fig. 4, will show that if half of the force which acts on *b* be represented by the line *b d*, then this force will determine on *b c* a tensile force or traction, which is represented by the length *b c*, and this tensile force or traction must resolve itself into two forces, one force of which is directed on *a c*, and the other on the normal *m c* to *o* L; it will then give for component in the direction of *m c*, a force represented by *c g*, the point *g* being determined by the intersection of *c m* with the line *b g* drawn from *b* parallel to *a c*. In other words, the force which will act normally on the lever *o* L, will be equal to $\frac{P'}{2} \frac{ge}{bd}$ or to $\frac{P'}{4} \frac{ge}{ab}$ or to $\frac{P'}{4} \frac{mc}{a}$; it will then be seen that the weight acting on the sleeve will produce on the ball levers a momentum proportional to the surface of the triangle *o m c*.

This momentum has for its value,

$$\frac{P'}{2} \frac{ge}{bd} . oc \text{ or } \frac{P' mc . oc}{a}.$$

On the other hand the momentum produced by the centri-

fugal force for a given speed is proportional to the surface of the triangle O L *n*.

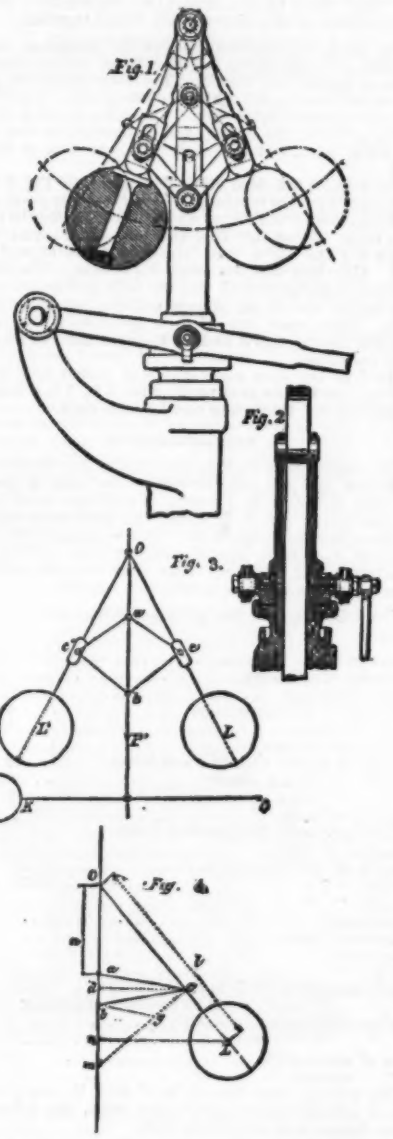
This momentum is equal to

$$\frac{P}{g} - w^2 . n l . o n.$$

Or it will be seen that for all the positions in the diagram, Fig. 4, the ratio of the surfaces of the similar triangles *o m c*, *o* L *n*, which have the constant hypotenuses, is invariable; it therefore results that if the equilibrium exists for a certain position of the system it will exist for all the others, supposing the speed of rotation does not change, that is to say, the apparatus will be strictly isochronal.

The ordinary speed is deduced from the equality of the two momenta previously considered:

$$\frac{P'}{a} . m c . o c = w^2 . n l . o n,$$



ANDRADE'S STEAM ENGINE GOVERNOR.

and replacing *m e . o c* and *n l . o n* by the proportional quantities 4 a^2 and p^2 the formula becomes

$$4 a P' = \frac{P}{g} . w^2 . p^2, \text{ which can be written } w^2 = \frac{4 a g P'}{P p^2}.$$

Suppose now that the weight acting on the sleeve be suppressed, then the governor or regulator will become an ordinary Watt governor, and the speed of rotation w_0 will be given by the formula,

$$w_0^2 = \frac{g}{h} \text{ putting } h = o n .$$

Let w_1 be the speed of the imaginary isochronal governor before considered, the centrifugal force being proportional to the square of the speed of rotation, it will then be seen that if the balls of the governor are not in equilibrium the governor itself will be in equilibrium at each moment for a speed w, determined by the rotation $w^2 = w_0^2 + w_1^2$, or in designating by—

N the number of revolutions per minute of the governor just considered,

N_0 the number of revolutions per minute of the imaginary corresponding isochronal governor,

N_1 the number of revolutions per minute of the corresponding Watt governor,

the relation will be $N^2 = N_0^2 + N_1^2$.

The square of the number of revolutions is therefore the sum of two terms, one of which, N_1^2, is independent of the position of the sleeve, and the other, N_0^2, is dependent of this position.

The following example is borrowed from a governor, the working of which is very satisfactory, to show that the variation of speed which results from the variable term may be dispensed with.

On this apparatus the limits of *h* are 0·25 m. and 0·27 m., the number of revolutions of the isochronal corresponding governor $N_1 = 150$; it therefore results that the speed of the apparatus is always included between—

$$\sqrt{\frac{g}{0{\cdot}25}\left(\frac{60}{2\pi}\right)^2 + 150^2} \text{ and } \sqrt{\frac{g}{0{\cdot}27}\left(\frac{60}{2\pi}\right)^2 + 150^2},$$

that is to say, between 161 and 160 revolutions per minute. The difference of the limits of speed is then lower than $\frac{1}{161}$, or 0·6 per cent. Practically it can be dispensed with, and more, this defect of absolute isochronism contributes to give to this governor a stability entirely sufficient.

By varying the position of the counterweight on the lever *o'* K, the speed may be varied. The majority of engines should always work at the same speed, but the displacement of the counterweight allows the apparatus to be regulated with great facility. A variable counterbalance weight can also be employed. In the greater number of isochronal governors, when the relative equilibrium is destroyed, the sleeve is in one direction submitted to a constantly increasing force, and in the other or contrary direction to a constantly decreasing force; it therefore results that when it is displaced in the first direction it becomes generally loose, while the displacement in the second direction is often effected too slowly.

The following are the advantages claimed by the inventor for this governor: 1. An isochronism as complete as can be desired. 2. A sufficient stability, superior to that of the majority of other isochronal governors. 3. A very large course or revolution. 4. Extreme simplicity. It also permits the speed to be changed while the engine is working by simply displacing a weight.—*Engineering.*

THE SOPER RIFLE.

MODERN warfare, as now seen in the East, more than ever demands that the simplest, safest, and quickest rifle should be placed in the men's hands. Without any doubt the most telling victories by the Turks have been greatly due to the fact that the men were armed with the Martini rifle adopted by our own Government. Since the decision, however, to adopt that rifle, the now well-known rifle of Mr. Soper has been brought out, and the older rifle, though good, has been eclipsed in respect of rapidity of fire and safety to the operator, by the new competitor. As some slight improvements have been made in this rifle since its appearance a few years ago, and since the time when its performance attracted so much attention, we give illustrations of its mechanism. Referring to these, A is the barrel; B, the stock; C, the breech shoe; D, the breech block; E, the lock box; F, the cock; G, the mainspring; H, the swivel; I, the main trigger; K, the striker; L, the bolt; M, the extracting lever; N, the extracting slide; O, the connecting rod; P, the tumbler; R, the lever; S, the breech trigger; T, the trigger spring; U, the side screw; V, the breech screw; W, the breech block pin; X, the nipple; Y, the trigger pin; Z, the side plate.

THE SOPER RIFLE.

The great advantage of this system of mechanism is that the breech block is made to act as a self-acting valve, the pressure from the charge forcing the breech block so closely against the breech shoe that it is impossible for any gas that may have escaped from a bad cartridge to get out in a rearward direction, or towards the firer's face; but it must at all times escape at the front joint of the breech block, and in an upward direction.

The lock is in principle identical with the Snider lock, except that it is mounted in the center of the rifle, so that it delivers its blow on the striker directly in line with the axis of the barrel. The mainspring, swivel, tumbler, and trigger action being similar to those in the Snider, the pull off of the trigger is equally reliable. The extracting slide is so arranged that about four times the pressure put on the lever R is brought to bear upon the cartridge, so that, by the rapid motion imparted, the case is thrown out of the rifle directly towards the rear.

The breech block, lock, and extracting action are all operated by the lever R on the right side of the rifle, so that, when it is in the ordinary position for firing, the lever will be between the thumb and forefinger of the right hand, being the most convenient position for immediate action when rapidity of firing is required. With this lever the breech can be operated without interfering with the lock, or, for purposes of instruction, the lock can be used without the breech, as an ordinary snapcap can be affixed to the nipple. An important point gained by the arrangement of the lever, R, is that the direction of fire and the range, when once found, need not be lost in reloading, so that a soldier, resting his rifle on earthworks, or lying down, when once he has got the range, can continue firing with effect, though the object of his fire may be occasionally hidden from view by clouds of smoke.

Of the points which recommend this rifle in preference to all others yet produced, we will not say anything more here, but we may, with reference to its performance, mention one fact, which shows that in accuracy of fire it is also excellent. At the trials which took place at Wimbledon in 1872, on one occasion when it was fired in the presence of government officials, out of forty-three shots fired in one minute at a target 6 ft. by 4 ft., forty-two of the bullets actually struck the target. The distance was 200 yards.

The conditions of the competition were that squads of four men should fire at the same time, but at separate targets, each man to stand at the "order arms" with his cartridges in the pouch supplied to him, and to commence firing by the word of command, continuing until the expiration of three minutes. 338 shots were fired by the squad using the Soper, being a little over eighty-four shots per man. Of 338 shots, 306 were hits, and with these 770 points were scored. The highest score ever registered at Wimbledon with any other rifle under similar conditions only reached 184, the points scored being 382, or less than half the Soper score.—*The Engineer.*

THE SOPER RIFLE.

The chief features of the rifle are that the breech block D is mounted on a pin W on the right side, so that the block moves upwards and towards the right, as in the Snider rifle, when open. The breech block is provided with a strong bolt, L, which passes through its center, and engages with a stud on the upper end of the connecting rod or link O, through which the breech block is operated by the lever R, so that when the block is closed ready for firing, the end of the bolt is forced out of the block into a recess in the breech shoe. The connecting link O, as well as pressing against the bottom of the breech block, passes into a slot in the latter, and so controls it and the transverse sliding motion of the bolt L, which passes the striker K by means of a slot. This arrangement prevents the possibility of the block being forced open at the moment of firing, as the mechanism of the lock and breech action is so arranged that the rifle cannot be fired unless the bolt and breech are home in their place.

SOLDERS.—Very fine and elaborate work is effected by using solders of different degrees of fusibility. For instance, a plate is soldered on with two carat gold; in that, another piece with silver, and so on; each subsequent solder being more fusible. In this manner jobs may be repaired that it would be impracticable to do by any other process.—*Metallarbeiter.*

INFLUENCE OF LIGHT ON METALS.—Some time ago M. Siemens discovered the influence of light on the electrical resistance of selenium, and constructed a new photometer based on this principle. Recent experiments have shown that light similarly acts upon tellurium, but in a less degree. In a note to the Philosophical Faculty of Heidelberg, M. Boernstein states that light also affects platinum, gold and silver, and probably all the metals.

THE BILLERICA AND BEDFORD TWO-FEET GAUGE RAILROAD.

THIS road, which has now been in operation for some months, has attracted a great deal of attention, from the fact of its being the first two-feet gauge railroad built in this country, and from its low cost, which is expected to be only about $6,000 per mile when the road is completed. The following particulars are from the *Railroad Gazette:*

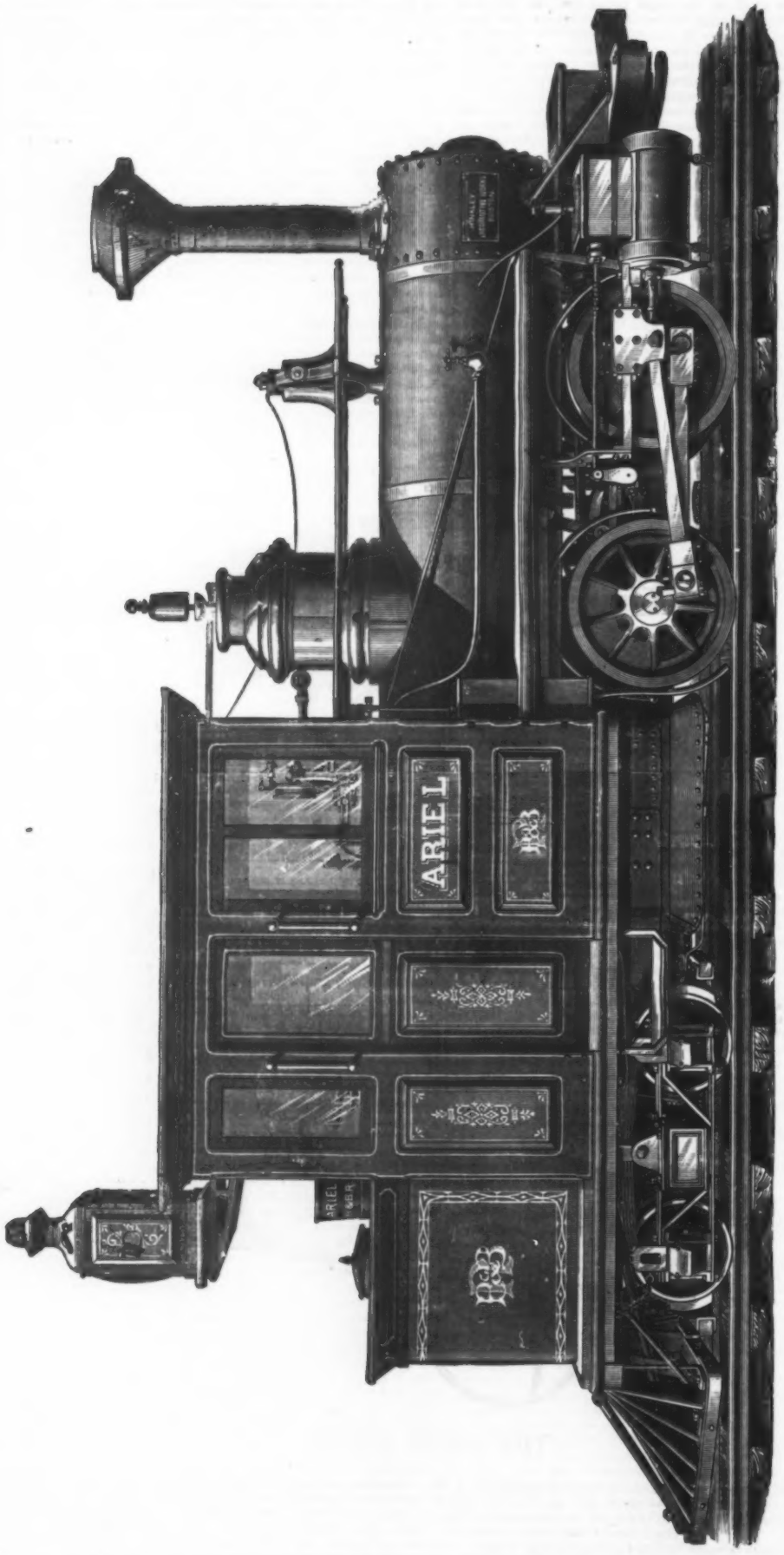
The road and its rolling stock were planned by Mr. Geo. E. Mansfield, of Bedford, Mass., and to him belongs the credit for the successful manner in which the whole project has been carried out.

The road extends from Bedford, a station on the Middlesex Central Railroad of Massachusetts, and not far from Lexington, the site of the first battle of the Revolution, northward 8·63 miles to North Billerica, a station on the Boston, Lowell and Nashua Railroad. It passes through ordinary New England farming country, with a number of villages on the line.

The following description of the engineering features of its location has been kindly furnished us by Mr. Hiram W. Blaisdell, the Chief Engineer, who located the line:

"The location of seven-eighths of the road is through a rough and rocky district, hard pan and cemented gravel predominating. The remainder of the line is through a sandy plain which requires but little grading exclusive of ditching and ballasting. Taken as a whole, the line may be said to run through an unusually difficult section, where a standard gauge would cost heavily.

"The deepest rock cut is on the incline south of Billerica Centre, and is nine feet deep for a short distance. To have avoided this ledge would have required a 120 feet grade where there is a 75 feet grade.



TANK LOCOMOTIVE FOR THE BILLERICA AND BEDFORD (2 ft. gauge) RAILROAD,
BY THE HINKLEY LOCOMOTIVE WORKS, BOSTON, MASS.
Weight of Engine in working order, 23,750 lbs. Cylinders, 8 in. diameter × 12 in. stroke. Driving Wheels, 30 in. diameter. Total Wheel Base, 13 ft. Driving Wheel Base, 3 ft. 6 in. Grate, 30 in. long × 27¾ ins. wide.

"The steepest grade is on the line between Bedford and Billerica Centre, and is 105$\frac{5}{10}$ feet per mile. The fall from Billerica Centre to North Billerica is 129 feet, giving an average grade of 60$\frac{5}{10}$ feet per mile.

"The entire road is to be ballasted with sand or gravel to the depth of twelve inches below the tops of the ties. The road-bed is six feet at grade on fills, and ten feet wide in cuts. Fig. 1 represents a cross section of a fill and Fig. 2 of a cut (see next page).

"The sharpest curve on the main line is 319$\frac{5}{10}$ feet radius (the elevation of the outer rail for this curve is 3½ inches); on the Y at Bedford, 129 feet radius. The locomotive is now running on a 250 feet curve with perfect ease. The engine and train will be turned on a Y at the Bedford station. Turn-tables will be used at Billerica Centre and North Billerica.

"The culverts in deep fills are either open or of cement pipe, while those in shallow fills, when they can be easily replaced, are made of pine lumber. There are six open culverts of from 8 to 15 feet span, one pile bridge 140 feet long, and ten cattle-ways. The mason work is first-class rubble masonry. The right of way generally adopted is 25 feet. There will be about 600 cubic yards of rock work and 30,000 cubic yards of earth excavation, including ballast.

"The culverts and bridges are calculated to sustain a safe center load of ten tons, the factor of safety used being as high as seven in all structures.

"The dimensions of timber used are as follows:

For 6 ft. culverts two timbers 8 × 10 ins.
" 8 " " " " 10 × 12 "
" 12 " " " " 10 × 14 "
" 15 " " " " 12 × 14 "
" 25 " spans for pile bridge two timbers 10 × 22 ins. or its equivalent in two pieces firmly bolted together."

The track follows the surface of the ground as closely as possible, and, therefore, the line is an almost continuous series of grades and curves. The total amount of grading was 43,000 cubic yards, with 542 cubic yards of loose rock and 640 cubic yards of solid rock. The price at which the earthwork, including the ballast, was contracted for was 35 cents per cubic yard, and the rock work was done at $1.50 per yard.

The rails, (a full-sized section is shown in Fig. 3 on next page), are of iron 30 feet long, weigh 25 lbs. per yard, and cost in Boston $38 per ton. They are fastened together by ordinary fish-plates. These are 15½ ins. long, and a pair of them weigh 5$\frac{1}{16}$ lbs. The bolts are ½ in. diameter and 2¼ ins. long. One bolt and nut weigh 4½ ounces. The fish-plates cost two cents per pound, and the bolts and nuts four cents. The spikes are $\frac{7}{16}$ in. square and 3$\frac{1}{2}$ ins. long under the head. There were 600 of these spikes to a keg, each keg weighed 150 lbs., and it took 16 kegs per mile, which cost 2$\frac{3}{4}$ cents per pound.

The cross ties were made of sawed timber, and, as shown in Figs. 1 and 2 (see next page), were 4 ft. 6 ins. long, 6 ins. wide and 4 ins. thick, and cost 12 cents each.

THE LOCOMOTIVES.

The engines were built by the Hinkley Locomotive Works, of Boston, and are constructed on the plan proposed and patented by Mr. M. N. Forney. The designs were, however, worked out by Mr. F. D. Child, the Superintendent of the works where they were built. This was done with so much skill and good taste that the engines have excited general admiration, and since they have been put into service they have worked in the most satisfactory manner.

The following are the principal dimensions of these engines:

Gauge of road	2 ft.
Diameter of cylinders	8 inches.
Stroke of pistons	12 "
Diameter of driving-wheels	30 "
Total wheel base	13 ft.
Driving-wheel base	3 ft. 6 in.
Weight of engine with fuel and water	23,750 lbs.
Weight on driving-wheels	14,350 "
" " truck	9,400 "
Capacity of tank	400 galls
Inside diameter of front end of boiler	30 ins.
Diameter of dome	18 "
Length of fire-box inside	30 "
Width " " " "	27¾ "
Height " " " "	37 "
Water space	2½ "
Number of tubes	70
Diameter " "	1¾ "
Length " "	6 ft. 7 "
Thickness of iron plates in shell of boiler	¼ "
" " steel " sides and back of fire-box	½ "
Thickness of steel tube-sheet	⅜ "
" " " crown "	½ "
Size of steam ports	6× ¾ "
" " exhaust "	6× 1¾ "

The driving-wheel tires to be of steel, the main pair to be flat or without flanges and 5½ ins. wide, the other pair to have flanges and to be 5 ins. wide.

Thickness of tires	2 in.
Diameter of wheel centers	26 "

Size of journals, 4 ins. diameter × 4 ins. long.

Truck frame to be of wrought iron forged solid, the jaws of cast iron.

Diameter of chilled cast-iron truck wheels, 18 ins.

Truck axles to have outside journal-bearings 5 ins. long × 2$\frac{5}{8}$ ins. diameter.

Engine to have one No. 3 and one No. 4 Mack's injectors.

A feature in these engines which is worthy of notice is the width of fire-box. With the ordinary methods of construction employed in this country, the fire-boxes on all engines, but especially on those for narrow-gauge roads, must be very much contracted. If the usual plans were followed in engines for a 2-ft. gauge road, the fire-boxes would necessarily be contracted still more than on a 3-ft. gauge road. For this reason, in designing these engines the method of construction was adopted which is shown clearly in the plan. It will be seen that the wheels are placed entirely beyond the fire-box, so that it can be spread out as wide as may be desired, and the frames are then abutted against the fire-box and attached to it with an expansion joint, so as to allow the boiler sufficient room for the movement which is due to expansion and contraction from heating and cooling. The frames which support the tank, and which rest on the truck, consist of flat plates strengthened with angle iron, and are bolted to the sides of the fire-box. This method of construction is admissible for an engine of so small a size, but it need not be resorted to for engines of a much larger size for the standard gauge. It will be seen, however, that it gives all the width of fire-box that is needed, an advantage which, it has been claimed, can only be realized on narrow-gauge roads by the use of the double-truck engines.

FREIGHT AND EXCURSION CARS.

The excursion cars are the same as the flat cars excepting the seats and the roof or awning over the seats. The box and flat cars are 23 feet long over the body and 6 ft. 2 ins. wide, or more than three times the width of the gauge. The weight of the box car is 5,600 lbs. and the capacity 16,000 lbs. The flat cars weigh 4,500, with the same capacity as

the box car. The excursion cars weigh 5,500 lbs. and have seats for 55 passengers. The road has one box car, six flat cars and two excursion cars. They are all equipped with the Miller coupler.

PASSENGER CARS.

The seats are arranged as in ordinary cars, excepting that each has room for only one instead of two passengers. They are placed 28½ ins. from center to center. This is considerably closer than on ordinary railroads, on which the seats

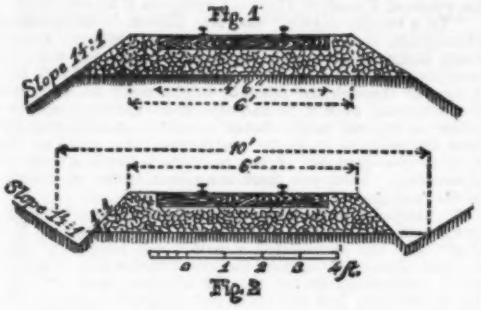


Fig. 2

are usually from 33 to 34 ins. apart. The cars are 35 ft. long over the bodies, and 40 ft. from end to end of the platforms, and 6 ft. 2 ins. wide outside. The wheels are 18 ins. in diameter, and spread 4 ft. from center to center.

The passenger car weighs 9,000 lbs., and seats 36 passengers. The combination car weighs the same, and seats 20 passengers, but with a compartment for baggage and express matter. Each truck, under both passenger and combination cars, weighs 1,748 lbs.

The freight and passenger cars were built by the Ranlet Car Manufacturing Company, of Laconia, N. H.

COST.

As we have stated before, the road is 8·63 miles long. There were in that distance 43,000 cubic yards of earth work and 542 cubic yards of loose rock and 640 of solid rock. The price paid for the grading was 35 cents per cubic yard for earth work and $1.50 for rock work. The cross-ties are 4 ft. 6 ins. long × 4×6-ins. section, and cost 12 cents each. The number laid per mile is 2,640, so that the distance between them measured from center to center is two feet. The rails weigh 25 lbs. per yard and are 30 feet long; the quantity per mile being 39½ tons, which cost in Boston $38

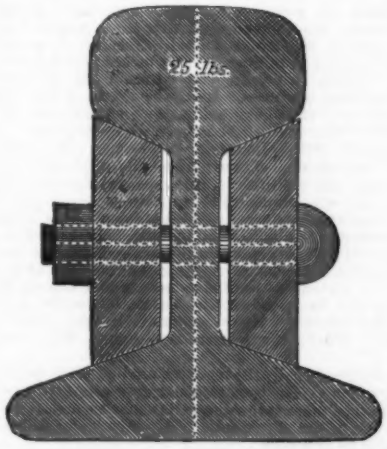


FIG. 3.

per ton. The spikes are $\frac{7}{16}$ in. square and 3½ ins. long measured under the head. The quantity used per mile was 2,400 lbs., which cost 2½ cents per pound. The rails are fastened with fish-plates 15½ ins. long, a pair of which weigh 5½ lbs. Each pair has four bolts ⅝ in. diameter and 2¼ ins. long. One bolt and nut weigh a trifle (⅛ oz.) over a quarter of a pound. The fish-plates cost 2 cents per pound and the bolts and nuts 4 cents, making the whole cost of a complete joint 14¾ cents. As there are 352 of them per mile, their cost for that distance is $51.92.

EQUIPMENT.

The equipment and its cost are as follows:

Two locomotives cost	$3,500	apiece.
One passenger car "	2,000	
One combination " "	1,950	
One box " "	360	
Two excursion cars "	490	"
Six platform " "	260	"
Two hand " "	65	"
Three push " "	35	"

The passenger cars have the Empire vacuum brake. The water supply is furnished from a wooden tank in the engine house, the capacity of which is 15,000 gallons.

The estimated cost of the road was $60,000, but this will probably be considerably exceeded when the road is fully completed.

THE BRACE PROBLEM.

To the Editors of the Scientific American:

Referring to the brace problem by A. C. Haverstick in your Supplement, No. 98, for November 17, 1877:—It is true that the brace is the largest rectangle of the given width that can be inserted in the rectangle, A, B, C, D, but, if the width is fixed and constant, it is the only rectangle that can be inserted in the panel in that position, that is from corner to corner, and is the minimum as well as maximum. Since the dimensions of the panel are constant quantities, it will not do to assume that the width of the brace is also a constant, for then the length becomes constant and the sides of the corner triangles, x and y, become immediately fixed and constant, and can never be regarded as variables. Hence the differential of any function involving them, as u, would be $= 0$, and the first differential coefficient would be $= \frac{0}{0}$, which is indeterminate and may be infinity. Mr. Haverstick finds the first differential coefficient, which he makes equal to zero, regarding x and y as variables, which is impossible for the above reasons, and obtains the equation $-\frac{2\,bx}{\sqrt{c^2-x^2}} - 2\,a = 0$; from this equation we have $-\frac{2\,bx}{\sqrt{c^2-x^2}} = 2\,a$. Now since the denominator is evidently positive, and a and b are both real quantities, the value of x in this equation must be negative, which is absurd, and this absurdity is not to be whitewashed by squaring both members to make them positive.

Mr. Haverstick finds $x^2 = \frac{a^2\,c^2}{b^2+a^2}$ and $y^2 = \frac{b^2\,c^2}{b^2+a^2}$ therefore $\frac{x^2}{y^2} = \frac{a^2}{b^2}$ or $\frac{x}{y} = \frac{a}{b}$; hence $x : y :: a : b$. Now, let us take a panel the length of which, AC, is twice the width, AB; then $a = 2\,b$, and by the solution $x : y :: a : b$ or $x : y :: 2\,b : b$ and $x = 2\,y$. Now the angle FEA + angle CEG are equal to a right angle, and equal to the sum of the angles FEA + EFA, hence the angle CEG = angle EFA, and the triangle AFE is similar to the triangle EGC, and we have CE : GC :: FA : AE or $a - y : b - x :: x : y$. Substituting the result of the solution, that is $x = 2\,y$, in this proportion, we have $a - y : b - 2\,y :: 2\,y : y$, making the product of extremes equal to product of means:

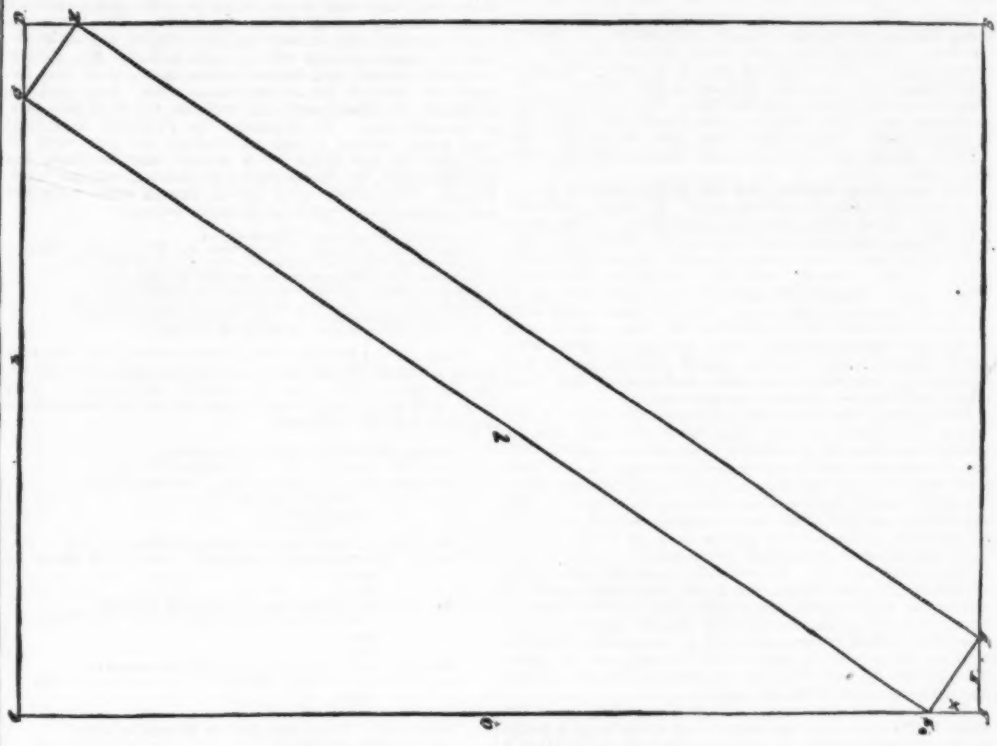
$y\,(a - y) = 2\,y\,(b - 2\,y)$ or dividing each
by y, $a - y = 2\,(b - 2\,y)$ hence
$a - y = 2\,b - 4\,y$ or
$3\,y = 2\,b - a$; but since $a = 2\,b$,

the second member of this equation is zero, and hence $3\,y = 0$, which is absurd. It is remarkable, too, that the result of the solution renders the value of x, which is assumed in the premises to be less than y, to be in fact greater. If the length $a = 20$, width $b = 10$, and width of brace $c = 2$, then $x^2 = \frac{a^2\,c^2}{b^2+a^2} = \frac{1600}{500} = \frac{16}{5}$ and $y^2 = \frac{b^2\,c^2}{b^2+a^2} = \frac{1}{5}$, but x was taken for AE, which is less than AF or y.

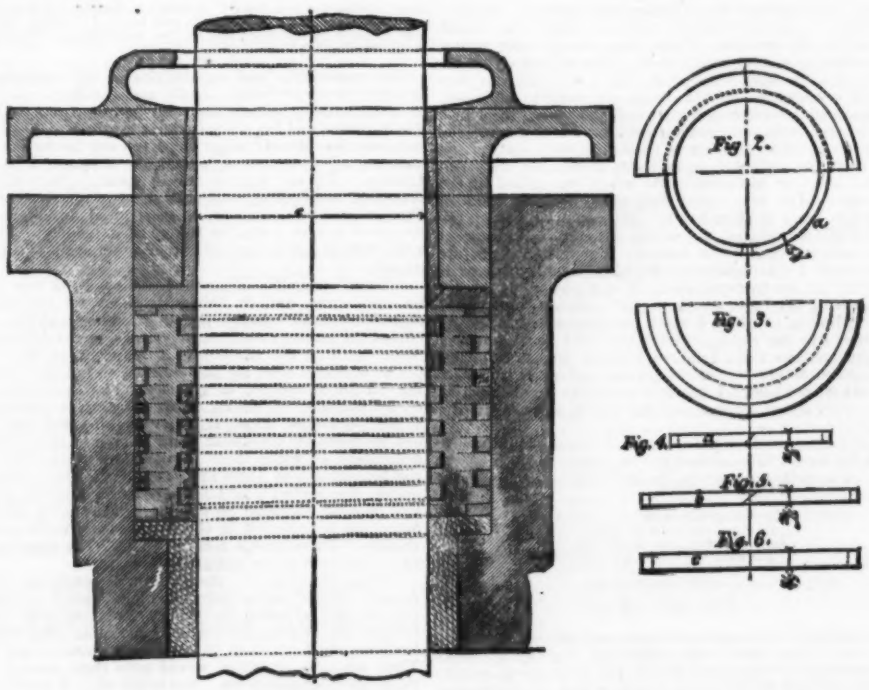
Respectfully,
Lexington, Mo. A. F. ALEXANDER.

METALLIC PACKING.

WE annex illustrations of a metallic packing for stuffing-boxes designed by Mr. M. Murray Jackson, of Buda Pesth, Hungary, and largely employed on the vessels of the Danube Steam Navigation Company. As will be seen, the body of the packing consists of a cast-iron bush bored out to fit the rod. This bush is made in halves, truly adjusted together, and on the inner surface a number of grooves are cut, into each of which a brass ring is introduced, as shown in Fig. 2. The halves of the bush are then brought together and held by two wrought-iron rings shrunk on at the top and bottom. The brass packing rings vary in dimensions with the size of the piston rod; those shown in the drawing for a rod 5½ ins. in diameter are $\frac{5}{16}$ in. thick by $\frac{7}{16}$ in. deep. They are bored out to a diameter slightly smaller than that of the rod, and are cut obliquely. On the outside of the cast-iron bush grooves are turned, into which cast-iron rings are sprung; the bush is then put in place and held by the gland, as shown. This packing has now been in use for a considerable time, and some of the brass packing rings have been running continuously for eighteen months without sensible injury to themselves or the rods.—*Engineering.*



THE BRACE PROBLEM.



JACKSON'S METALLIC PACKING.

THE SPEAKING PHONOGRAPH.

THE writer lately visited Menlo Park, N. J., to chat with Prof. Thomas A. Edison. This gentleman is the inventor of the automatic telegraph, quadruplex and sextuplex dispatches, the carbon telephone, the stock indicator, the electric pen, the airophone, the marvelous speaking phonograph, and a score or more of similar machines. He is also the discoverer of the electro-motograph, by which dispatches may be telegraphed without magnetism. Scientific men regard it as his greatest discovery, and predict that it will some day prove of immense value.

Menlo Park is a small place on the line of the New York and Philadelphia Railroad, two miles north of Metuchin. Mr. Edison's manufactory stands forty rods west of the depot. A high bank shuts out the view from the car windows. The building is a long wooden structure, something like an old-fashioned Baptist tabernacle. It faces to the east. Nine lightning rods pierce the sky above it. A dozen telegraph wires are led into it by sentry-like poles connecting with the main line along the railroad. The front doors open directly into the office. The writer entered. A man sat at a table studying a mechanical drawing. An inquiry for Mr. Edison drew from him the words, "Go right up stairs, and you'll find him singing into some instrument."

The stairs were climbed, and the writer stepped into a long room forming the second story. It was an immense laboratory, filled with electrical instruments. A thousand jars of chemicals were ranged against the walls. A circle of kerosene lamps was smoking viciously on an empty brick forge. Their chimneys were the essence of blackness. There was no disagreeable smell, for the smoke was borne off by the draught of the forge. An open rack loaded with jars of vitriol stood in the middle of the room, and the rays of the sun struck through them, flecking the floor with green patches. The western end of the apartment was occupied by telephones and other instruments, and there was a small organ in the southwestern corner.

Prof. Edison was seated at a table near the center of the room. He looked like anything but a professor, and reminded me of a boy apprentice to an iron moulder. His hands were grimy with soot and oil; his straight dark hair stood nine ways for Sunday; his face was entirely beardless, but sadly needed shaving; his black clothes were seedy, his shirt dirty and collarless, and his shoes ridged with red Jersey mud; but the fire of genius shone in his keen gray eyes, and the clean cut nostrils and broad forehead indicated strong mental activity. He seems to be always looking for something of great value, and to be just on the point of finding it. Unfortunately he is quite deaf, but this infirmity seems to increase his affability and playful boyishness. A man of common sense would feel at home with him in a minute; but a nob or prig would be sadly out of place. Though but 31 years old, the occasional gleam of a silvery hair tells the story of his application.

The Professor was manipulating a machine upon the table before him. He had something resembling a gutta-percha mouthpiece of a speaking-tube shoved against a cylinder wrapped in tinfoil, which he turned with a crank. The small end of a tin funnel was clapped over the mouthpiece, and strange ventriloquial sounds were issuing from it. He shook hands, and pointing to the instrument said: "This is my speaking phonograph. Did you ever see it and hear it talk?"

The reply was a negative. Thereupon, he picked up the gutta-percha mouthpiece, saying, "This mouthpiece is simply an artificial diaparagm. Turn it over," suiting the action to the word, "and you see this thin disk of metal at the bottom. Whenever you speak in the mouthpiece the vibrations of your voice jar this disk, which, as you see, has in its center a fine steel point. Now for the other part of the machine. Here is a brass cylinder grooved something like the spiral part of a screw, only much finer. I wrap a sheet of tinfoil around the cylinder, and shove the mouthpiece up to it so that the tiny steel point touches the tinfoil above one of the grooves. I then turn the cylinder with a crank, and talk into the mouthpiece. The vibrations arouse the disk, and the steel point pricks the tinfoil, leaving perforations resembling the old Morse telegraphic alphabet. They are really stereoscopic views of the voice, recording all that is said, with time and intonations. It is a matrix of the words and voice, and can be used until worn out. Now let us reset the cylinder, so that the steel point may run over the holes or alphabet made when we talked in the mouthpiece. The thin metal disk rises, and, as the steel point trips from perforation to perforation, opening the valves of the diaphragm, the words, intonation, and accent are reproduced exactly as spoken. For instance, before you came up, I was talking to the instrument, and here is the matrix or stereoscopic view, if you please, of what I said," putting his finger on the tinfoil which still remained on the cylinder. "Now I reset the instrument," sliding the cylinder to the right. "Here the steel point starts at the same spot as when I talked through the mouthpiece, but its action is now controlled by the perforated alphabet. It repeats what I said. I use this sort of an ear trumpet to bring out the sound, so that you can hear it more distinctly. Listen."

He placed the small end of the funnel over the mouthpiece, shoved the mouthpiece against the cylinder, and turned the crank. The following words chased each other out of the funnel:

Mary had a little lamb,
Its fleece was white as snow,
And everywhere that Mary went
The lamb was sure to go—to go—to go—
Ooh ooh ooh—ah!
Cockadoodle doo—ah!
Tuck—a—tuck—a—tuck!
Tuck—ah! tuck—ah!

The cylinder was again set back, and the crank turned very slow. The effect was ludricrous, for the Professor had originally pronounced the words with great gravity and dignity, and the drawling way in which the instrument repeated them would have made a horse laugh. The cylinder was then turned very fast, and the words flew out of the funnel so fast that they struck the ear in a confused mass. But a most extraordinary effect was produced when the Professor turned the cylinder backward. It said:

Go to sure was lamb the,
Went Mary that everywhere and,
Snow as white was fleece its,
Lamb little a had Mary.

All this with profound gravity, as if the fate of the world depended upon the accent and pronunciation. Mr. Edison then tore off the tinfoil and wrapped a fresh sheet around the cylinder. One of old Mother Goose's rhymes was murmured into the mouthpiece, and its alphabet pricked out by the action of the steel point. The cylinder was then reset, and the crank turned, with the following result:

Rub a dub dub,
Three men in a tub,
And who do you think was there?
The butcher, the baker,
The candlestick maker,
They all jumped out of a rotten potato.

The instrument is so simple in its construction, and its workings so easily understood, that one wonders why it was never before discovered. There is no electricity about it. It can be carried around under a man's arm, and its machinery is not a fiftieth part as intricate as that of a sewing machine. It records all sounds and noises. The Professor blew in it at intervals, and the matrix recorded the sound and returned it. He whistled an air from the "Grande Duchesse," and back it came clear as a fife, and in perfect time. He rang a small bell in the funnel. The vibrations were recorded, and, on resetting the cylinder, the tintinnabulatory sounds poured out soft and mellow. Mr. Edison coughed, sneezed, and laughed at the mouthpiece, and the matrixes returned the noises true as a die. But, most remarkable, the instrument sent back the voices of two men at the same time. To illustrate: The Professor, in a deep bass voice, recited in the mouthpiece the first verse of "Bingen on the Rhine." A matrix was obtained, the machine reset, the funnel placed in position, and the crank turned. The words came out as though some tragedian was endeavoring to affect an audience to tears:

A soldier of the legion lay dying in Algiers,
There was lack of woman's nursing, there was lack of woman's tears,
But a comrade stood beside him while his life blood ebbed away,
And bent with pitying glances to hear what he might say,
The dying soldier faltered, and he took that comrade's hand,
And he said, "I never more shall see my own, my native land;
Take a message and a token to some distant friends of mine,
For I was born at Bingen—at Bingen on the Rhine."

While these affecting words were pouring out, the Professor shouted into the funnel several petulant exclamations. At the close of the verse the cylinder and its matrix were reset, and the recitation again came out of the funnel, interruptions and all, as follows:

A soldier of the legion lay dying in Algiers,
— — "Oh shut up!" — — — "Oh, bag your head!"
There was lack of woman's nursing, there was lack of
— — — — — "Oh, give us a rest!" — — — — — — — — — —
woman's tears,
— — "Dry up!"
But a comrade stood beside him while his life blood ebbed
— — — "Oh, what are you giving us!" — — — "Oh, cheese
away,
it!"
And bent with pitying glances to hear what he might
— — — — "Oh, you can't recite poetry!" — — — — "Let
say,
up!"
The dying soldier faltered, and he took that comrade's
— — — — — "Police! Police!" — — — — — — — "Po-
hand,
lice!"
And he said, "I never more shall see my own, my native
— — — "Oh, put him out!" — — — — — "Oh, cork your-
land."
self!"

It is impossible to describe the ludicrousness of the effect. The Professor himself laughed like a boy. One of his assistants told a story concerning a trap laid for a well-known divine, who was skeptical regarding the capabilities of the instrument, and evidently had a suspicion that the Professor was a ventriloquist. He wanted to talk into the mouthpiece himself, and see if his own words would be recorded and repeated. A matrix was put on the cylinder that had been used once before. The Doctor repeated a Scripture quotation, and, to his great astonishment, it came out as follows:

He that cometh from above is above all ["Who are you?"]; he that is of the earth ["Oh, you can't preach!"] is earthly and speaketh of the ["I think you're a fraud!"] earth; he that cometh from heaven is above all. And what he has seen and heard ["Louder, old pudding head!"] that he testifieth; and no man receiveth his testimony ["Oh, go and see Beecher!"].

The possibilities and capabilities of this remarkable instrument are wonderful. Dolls and toy dogs can be made to recite nursery ballads, and wax figures of notabilities can use the voice and language of their originals. A prominent showman has already taken steps toward the formation of a museum of wax figures similar to Madame Tussaud's in London. All the figures are to speak. Matrixes of the voice and words of a gentleman whose imitations of Edwin Forrest are astonishing are to be secured, and placed in the breast of a wax statue of the great tragedian. The voice and outward appearance of Mr. Forrest are to be perfectly copied.

"Why," says Mr. Edison, "Adelina Patti can sing her sweetest arias, and by this instrument we can catch and reproduce them exactly as sung. The matrixes can be copied the same as stereoscopic views, and millions sold to those owning the machine. A man can sit down in his parlor at night, start his phonograph, and enjoy Patti's singing all the evening if he chooses. The same with Levy's cornet playing. A matrix of his solos can be produced, and a million copies taken, and Levy's solos and Patti's arias can be given ten thousand years from now as perfectly and accurately as when these great artists were alive. If the last benediction of Pope Pius had been taken by the phonograph, the matrix could have been duplicated, and every true Roman Catholic on the face of the earth might have heard the benediction in the Pope's own voice and accentuation. There was a fortune in it. The matrixes could have been sold at five dollars apiece.

"Poor churches in the country," continued the Professor, "might have these machines rigged up over their pulpits, and by using the proper matrixes, could have Dr. Chapin, Dr. Bellows, Beecher, or any other great theological light expound to them in their own voices every Sunday. Thus the poor churches would save their money, and get rid of the poor preachers. Nor is this all. A man in Europe has invented a machine by which he takes an instantaneous photograph. Let us suppose that he photographs Dr. Chapin every second, and we take down his sermon on the matrix of the phonograph. The pictures and gestures of the orator, as well as his voice, could be exactly reproduced, and the eyes and ears of the audience charmed by the voice and manner of the speaker.

"Whole dramas and operas," continued Mr. Edison, his eyes sparkling with excitement, "can be produced in private parlors. The instrument can be used in a thousand ways. Say I hire a good elocutionist to read David Copperfield or any other work. His words are taken down by machine, and thousands of matrixes of David Copperfield produced. A man can place them in the machine, and lie in bed, while the novel is read to him by the instrument with the finest grade of feeling and accent. He can make it read slow or fast, can stop it when he pleases, and go back and begin again at any chapter he may choose. I could fix a machine in a wall, and by resonations any conversation in a room could be recorded. Political secrets and the machinations of Wall street pools might be brought to light, and the account charged to the devil. Kind parents could lie in bed and hear all the spooney courtship of their daughters and lovers. A man who loved the music of the banjo or the fiddle could buy his matrix and listen to Horace Weston or Mollenhauer whenever he liked. He could have the whole of Theodore Thomas's orchestra if he wanted it.

"To a certain degree," said Mr. Edison, "the speaking phonograph would do away with phonography. A man could dictate to his machine whenever he pleased, turn the machine over to an amanuensis, and let him write it out. A lawyer through the machine might make an argument before a court, even if he had been in his grave a year. An editor or reporter might dictate a column at midnight and send the machine up to the compositor, who could set the type at the dictation of the machine without a scrap of manuscript. I tell you there is no limit to the possibilities of the instrument."

At this point in the conversation the Professor sat down at his table and hallooed "Mad dog!" "Mad dog!" "Mad dog!" into the phonograph a half dozen times, and then amused himself by turning the crank backward. Then he made the instrument tell the old affecting story of Archibaldas Holden, and lay back and laughed heartily. We asked how soon the phonograph would be thrown upon the market.

"We expect to offer them for sale within two months," said the Professor. "The price of the finest machine will be about $100, but we shall sell inferior ones at a much lower price. The matrixes will be for sale like sheets of music, and can be used upon all the machines."

One of the remarkable features of the invention is the fact that the diaphragm can be placed in steam whistles and made to talk like a calliope. The captains of ships at sea miles away from each other could converse without trouble and correct their chronometers. The steam whistles would throw any voice into articulated speech. With a metal diaphragm in the whistle of a locomotive the engineer could roar out the name of the next station in a voice so loud that it could be heard by every passenger on the train and by every man within a distance of two miles. Placed in a steam fire engine, the chief engineer could talk to every foreman in the department without difficulty, no matter how great the uproar. A machine might be put up in the Jersey City Railroad depot that would shout "This side for Newark, Elizabeth, Rahway and New Brunswick! Train on the left for Philadelphia, Baltimore and Washington! Show your tickets!"

"Why," said the Professor, "I could put a metal diaphragm in the mouth of the Goddess of Liberty that the Frenchmen are going to put up on Bedloe's Island that would make her talk so loud that she could be heard by every soul on Manhattan Island. I could drop one in a calliope and set it talking so that men could hear it miles away. Within two years you will find the machine used for advertising purposes. It will be sitting in the windows of stores on Broadway and other streets singing out, 'Babbitt's best soap,' '*New York Sun*—price two cents,' 'Brandreth's Pills,' 'Longfellow's Poems,' 'Ten cents for a shave!' and so on. There is no end to its uses. It will sing songs and whistle. A man has already made application to use the phonograph in cabs, so as to record the complaints of passengers. The Ansonia Clock Company of Connecticut have one in their manufactory this minute, and it shouts 'Twelve o'clock!' and 'One o'clock!' so loud that it is heard two blocks off. One might be used as an alarm clock. If its owner wanted to get up at a certain time in the morning, he could set the alarm, and at the appointed hour the machine would scream 'Halloo, there! Five o'clock! What's the matter with you? Why don't you get up?"

The Professor calls the machine applied to steam whistles the airophone. He is now constructing one to put up in front of his manufactory, and intends to make it talk so that it can be heard two miles. He says "Old Bill Allen of Ohio will be nowhere."

Several of his speaking phonographs have been sent to England, where they have created a profound sensation. Mr. Edison says that he received a cable dispatch on Friday last, offering him £3,000 and half the profits for the right to sell the instrument in that country.

"How did you discover the principle?" asked the writer.

"By the merest accident," said the Professor. "I was singing to the mouthpiece of a telephone, when the vibrations of the voice sent the fine steel point into my finger. That set me to thinking. If I could record the actions of the point, and send the point over the same surface afterward, I saw no reason why the thing would not talk. I tried the experiment first on a strip of telegraph paper, and found that the point made an alphabet. I shouted the words 'Halloo! halloo!' into the mouthpiece, ran the paper back over the steel point, and heard a faint 'Halloo! halloo!' in return. I determined to make a machine that would work accurately, and gave my assistants instructions, telling them what I had discovered. They laughed at me. I bet fifteen cigars with Adams here [Adams was lying on the table listening to the conversation—REP.] that the thing would work the first time without a break, and won them. I bet two dollars with the man who made the machine, and won them also. That's the whole story. The discovery came through a pricking of the finger."

Here Mr. Edison, in a deep bass tone, shouted in the instrument:

"Nineteen years in the Bastile!
I scratched a name upon the wall,
And that name was Robert Landry,
Parles vous Français? Si habla Español.
Sprechen sie Deutsch?"

And the words were repeated, followed by the air of "Old Uncle Ned," which the Professor had sung.

On being questioned concerning his telephone, the Professor said: "I went to work before Professor Bell. Elisha Gray turned in at it, and got out the first machine. Bell's and mine came out about the same time. The machines are different. Bell's is what is called the magneto telephone, and mine the carbon. Those kerosene lamps that you see smoking yonder are my carbon manufactory. I peel it from the shades, and press it into buttons for use in my telephone. Were it not for my deafness, I would have discovered the telephone eight months before. While trying an experiment my deafness led me off on a wrong tack, and I was sloshing around on a false scent for months. But I have produced a good instrument. I have whispered into it here at Menlo Park, and been answered in a whisper by

Henry Bentley in the Western Union office at Philadelphia." Here the clock struck 3, and we started for the train. The Professor returned to his machine like a delighted boy, and as we left the house we could hear him gravely asking:

"How far is it from New York to Albany, from Albany to Syracuse, from Syracuse to Buffalo, from Buffalo to Cleveland, from Cleveland to Columbus, from Columbus to Cincinnati, from Cincinnati to Louisville, from Louisville to Nashville, from Nashville to —"

and so on ad infinitum till we were beyond hearing.—*N. Y. Sun.*

ON THE LAW OF THE ABSORPTION OF RADIATIONS ACROSS BODIES, AND OF ITS APPLICATION IN QUANTITATIVE SPECTRAL ANALYSIS.

By M. G. GOVI.

IF an absorbent medium is interposed in the path of the white light which passes by the slit of the spectroscope, we generally see obscure bands appear in different parts of the spectrum, which diminish the brightness of the colors and even extinguish them completely. It is very rare that these bands do not encroach upon a large number of the lengths of contiguous waves. If we augment the thickness of the absorbent medium we often see new shaded bands appear between the former, but there invariably occurs a deepening and a progressive dilatation of the first bands, so that for a certain thickness of the medium the whole spectrum is invaded by the shadow and enfeebled to such an extent that it may be regarded as altogether extinct.

This progressive enlargement of the absorption-bands strikingly recalls the increase in number and the dilatation of the luminous rays, which many observers have remarked in the spectra of incandescent gases in proportion as their rarefaction is diminished and their temperature increased. All the rays of the spectrum, visible and invisible, present analogous phenomena, and if only the luminous rays are mentioned here it is because their study is more convenient and more general than that of the ultra-red or ultra-violet radiations.

It is easy to see that the absorbent power of any substance is not sufficiently characterized by the appearance of such or such a dark band in the spectrum of white light which has traversed such or such a thickness of it. It is needful to know all the modifications which it may produce in the spectrum, from the feeblest and the most limited up to that which produces the apparent extinction of all radiation.

To observe directly spectral curves of equal absorption it is sufficient to give to the absorbent bodies the form of a prism, more or less acute, which is applied by one of its plane surfaces against the slit of the spectroscope. The edge of the prism is placed at one of the ends of the slit, parallel to its width, and there is thus obtained, over the whole length of the aperture, an absorbent medium, the thickness of which increases uniformly from zero (at the place of the angle) up to a certain maximum, which depends on the angle of the prism and on the length of the slit. The deviation due to the prismatic form of the medium may be destroyed by opposing to the first prism a second, of a material as little absorbent as possible, such as rock-salt, fluor-spar, quartz, glass, water, or alcohol, etc. The angle of the second prism is easily calculated by approximation, but, in case of need, it may be rendered variable within limits sufficiently wide to insure a compensation almost perfect.

If we place in this manner an absorbent medium of variable thickness before the slit of a spectroscope illuminated by perfectly white light, *i.e.*, the light of incandescent solid bodies, the spectrum no longer appears, as ordinarily, uniformly luminous in all its height, but we distinguish in it shadows, more or less undulated or denticulated, which represent to the eye the law according to which the coefficient of absorption of the medium varies with the wave-length of the incident light. If we divide the slit into two parts in the direction of its length, and employ each of these two parts to produce a spectrum with curves of chromatic absorption, the two spectra will be found in juxtaposition in the direction of their length, and it will be easy to compare the curves and recognize their equality or their differences. We may even by a very simple artifice cause two spectra of one and the same absorbent medium in two different degrees of concentration to slide one over the other, recognizing thus zone of equal intensity, and thus apply the spectroscope to the quantitative determination of the substance used as a medium.—*Comptes Rendus.*

ELECTRICAL AND TELEGRAPHIC NOTES.

WE find the following in the *Telegraphic Journal:*

At the recent general meeting of the Society of Telegraph Engineers, London, the splendid electric light, of 1,200 candles intensity, produced by a magneto-electric machine of Messrs. Siemens, commanded the admiration of all. The light from the glowing carbon points was reflected upward upon a screen of white linen suspended from the roof, and thence reflected down again upon the auditory. It was curious to observe the fleecy whiteness of the screen when the light played upon it, a diffused whiteness resembling that of a sunlit cloud or the surface of new-fallen snow; and we can recommend it as a theatrical effect or as a source of diffused light in photography.

Besides the electric light, a bichromate cell, invented by Dr. Burns, an American, and yielding a current whose strength is extraordinarily increased by pumping air into the liquid by a hand syringe, was exhibited.

Also a piece of Edison phonograph slip, with recorded speech upon it. The slip was of tin-foil, and covered with minute indentations.

New Electrical Law.—Clausius announces the following general law, of which many of the known laws of electrical reciprocity are immediate consequences. Suppose there to be any number of conductors, C_1, C_2, C_3, etc., which mutually influence each other; let them receive two different charges of electricity. At the first charge, let the respective quantities in the different bodies be Q_1, Q_2, Q_3, etc., and the resulting potentials V_1, V_2, V_3, etc. At the second charge let the corresponding values be Q_1', Q_2', Q_3', etc., and V_1', V_2', V_3', etc.; then we shall find $V_1 Q_1' + V_2 Q_2' + V_3 Q_3' +$ etc., $= V_1' Q_1 + V_2' Q_2 + V_3' Q_3 +$ etc., or taking the sums, $\Sigma V Q' = \Sigma V' Q$.—*Annalen d. Phy. u. Chim.*

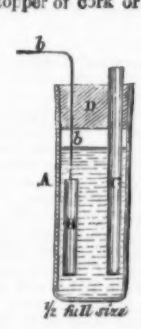
The Telephone and the Queen.—On the evening of January 14th Professor Graham Bell had the honor of exhibiting to the Queen the marvelous capabilities of the telephone. The trial took place in the Council Chamber of Osborne House, Isle of Wight, in presence of Her Majesty, the Princess Beatrice, the Duke of Connaught, and others of the Court. A temporary line three-quarters of a mile long had been erected between Osborne House and Osborne Cottage, the residence of Sir Thomas Biddulph, and the experiments began by the Princess Beatrice speaking with Lady Biddulph. At Osborne Cottage Miss Kate Field, the well-known American vocalist, sang "Kathleen Mavourneen," "Coming through the Rye," and the "Cuckoo Song," then recited the epilogue of *As You Like It*, all of which were distinctly heard by the royal party, and so well appreciated that the Queen thanked the singer personally through the telephone. Communication was then established with Cowes, where Major Webber, R.E., was superintending. Here several part songs were sung by a quartet, and plainly heard at Osborne. At Southampton, which was switched in circuit somewhat later by Mr. W. H. Preece, a bugle call sounding the "Retreat" fell on the hushed ears of the assembly in the Council Chamber like a distant echo, and produced a stirring impression. It is remarkable that, whereas for ordinary speech or music the ear requires to be close to the telephone in order to hear anything at all, the bugle note was heard by every one present, though standing several yards from the receiving telephone. At the conclusion of the experiments London was connected up to Osborne, and tunes played on Mr. Bell's telephonic organ in London were plainly heard by the royal party.

Telephone-iana.—In a recent lecture at the London Institution, Professor Barrett mentioned that a cheap, makeshift telephone could be made from an empty tooth-powder box, by making a hole in the bottom about the size of a half-crown, and fixing over it a disk of sheet iron (such as can be cut from the lid of a meat-tin) by means of the cover of the box. A small bar magnet, having an ordinary thread reel wound with insulated wire stuck on one pole, completed the necessary parts of the contrivance. Professor Barrett stated that with telephones made in this way he had been able to converse over a distance of 100 yards.

CHLORIDE OF SILVER CELL.

THE annexed figure represents a small form of De la Rue's chloride of silver cell, which is remarkably well adapted for electrical testing, either on shore or at sea. We have already had occasion to mention the special qualities in favor of this cell for such a purpose—its very constant electro-motive force from time to time, and especially during the taking of insulation resistance tests, its freedom from variation in electro-motive force when shaken or otherwise disturbed, its small portable form and cleanliness, and its comparative economy in the end. We hear that it is already coming into use as a testing battery.

In the diagram, A is a glass vessel, closed at the top to keep out dirt by a stopper of cork or solid paraffine, D, but



preferably of cork, because it can be handled with more ease and fits the cell more tightly than paraffine, which is apt to work loose when fitted to glass.

The negative pole, C, consists of a cylindrical rod of chemically pure zinc supported by the cork stopper, which is perforated to receive it. The zinc rod has a hole in the top to allow the silver connecting wire or electrode which goes to the next element to be soldered in.

The positive pole consists of a cylinder of silver chloride, B, having a silver wire or electrode, *b*, cast into it. This chloride rod is usually inclosed in a hollow cylindrical diaphragm of fine parchment paper.

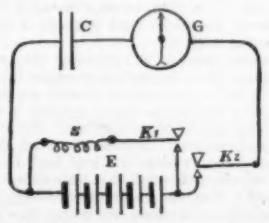
The solution for charging the cell is made by dissolving 23 grammes of pure sal-ammoniac or ammonium chloride in one liter of water.

The electro-motive force of each element is about 1·10 volt, and the internal resistance is about 8 ohms. Both of these qualities are very constant.

In the action of the cell, pure silver is reduced and deposited on the floor of the cell. To prevent the short circuiting of the poles by this metallic deposit, it is best to keep the zinc rod raised about three-eighths of an inch above the floor of the cell. This pure silver deposit can be readily turned into chloride of silver again by means of a small quantity of chlorine, and it is then only necessary to melt the chloride so formed, and recast it into rods for use over again, otherwise the pure silver may be sold as it is. Twenty, fifty, or even a hundred of these cells can be fitted with solid paraffine into a small box easily carried in the hand, so as to form a convenient portable testing battery for the use of electricians abroad. For medical men employing the feeble current cure this cell is also highly convenient.—*Telegraphic Journal.*

MEASUREMENT OF THE RESISTANCE OF A BATTERY.

THE following modification of the ordinary method of testing the internal resistance of a battery by means of a condenser is said to give good results. In the accompanying



diagram, E is the battery, whose resistance is required; C is a condenser, G a galvanometer, S a shunt, and K_1 and K_2 are two keys for making contact. In making the test by the ordinary method, as is well known, the key K_1 is first depressed, and the deflection on the galvanometer due to the charging of the condenser by the whole battery current observed. The condenser is then discharged, and the battery shunted with S, and a second deflection observed on the galvanometer, namely, that due to the reduced battery current. From these two deflections the resistance, *r*, of the battery is found by the formula,

$$r = \frac{D - D^1}{D^1} \times S,$$

where

r = resistance of battery in ohms,
S = resistance of shunt in ohms,
D = deflection obtained with battery unshunted,
D^1 = deflection obtained with battery shunted.

It is advantageous in making this test to observe D^1 as soon as possible after the shunt, S, has been applied to the battery, since its application changes the internal state of the battery by altering the conditions of working, especially if it be small. The best result would be obtained at the instant when the making contact with K_2 inserts the shunt. Instead of charging the condenser two separate times, however, it is only necessary to charge it once, namely, when taking the full deflection, D. If, while it is thus charged, the shunt, S, is inserted by depressing the key K_2, this has the effect of partially discharging the condenser, and causing a back throw on the galvanometer. This reverse deflection deducted from the full deflection, D, should give a highly correct value for D^1, since it is due to the instantaneous application of S.—*Telegraphic Journal.*

COLLODIONIZED TISSUE.

ALREADY it has been several times proposed in the *Archiv* to overcome various defects in the carbon process by coating the bichromated gelatine tissue with collodion, or dipping the tissue bodily into this liquid. According to Herr H. Norden there is nothing to fear from reticulation or grain in the tissue under these circumstances.

The question whether the tissue purchased in commerce could not be advantageously prepared already with this coating of collodion, is one which should not be overlooked. Were this the case there would be no longer any necessity for collodionizing glass plates, a circumstance which would materially simplify printing in pigments. Herr R. Jastrzembski has recently pointed out the advantages which would accrue from such a course.

In the first place, as just pointed out, the washing of the plates and the collodionizing of them would at once be spared. The finished picture is easily removed from the glass surface on which it has been developed. Secondly, there is no chance of any creasing of the tissue during development, by reason of the same having previously been of a horny character, so long as a film of collodion stretches over the surface. Of this one may easily convince one's self by taking an old piece of tissue and covering it with collodion. You will be surprised how cleanly and delicately the picture is developed, while the same tissue treated in the ordinary manner, without this method, will fail to give any satisfactory results at all. So that if the precautionary measure of collodionizing the tissue were taken, nothing is to be feared from summer heat and hot dry weather.

Herr Jastrzembski further says:—Of a number of plans which I tried, I found the following to be the best:—A piece of tissue of certain size is stretched, by means of drawing pins, upon a board, and then coated with collodion in the ordinary way, as if it were a glass plate with collodion containing one and a half per cent of pyroxyline in solution. As soon as the collodion is half set it is taken from the board, quickly immersed in water, and moved to and fro until all signs of greasiness have disappeared, when it is placed to dry upon a slanting board. When perfectly dry the tissue is rubbed over with the well known wax and turpentine mixture, so that very little of this remains behind. This film must be quite dry before the tissue is used any more. Prepared in this way, the tissue may be made use of the next day, and will, of course, remain in good condition in an unsensitized condition for a long while. Tissue thus prepared could be very well manufactured for commercial purposes.

The manipulations are as follows. The tissue thus prepared is put into a sensitizing bath composed of—

Bichromate of potash	4 parts
Carbonate of soda	1 part
Water	120 parts

The tissue is immersed in this bath for a period of three minutes: it is then dried and printed in the ordinary manner. To develop, it is put first of all into cold water, and placed upon a clean glass plate under water. Plate and tissue are lifted out together, and the latter is rubbed down with a strip of cardboard instead of rubber squeegee. It is well to place the plates ready for developing one upon the other with a sheet of bibulous paper between, and having weighted them to allow them to remain in this state for a quarter or half an hour—longer than this rather than shorter.

In actual development, it is best to begin at once with very warm water; the paper backing must not, however, be removed until, when touched with the finger, it slides easily from the glass plate; it is then lifted with the utmost care.

After complete development the image is put into a five per cent alum solution for half an hour, when it is rinsed with cold water and dried. The transfer of the tissue takes place in the ordinary way; artificial drying should not be resorted to.

The retouching of the pictures is best done with some of the gelatinous pigment softened in lukewarm water and treated with a few drops of acetic acid. Any pictures which require much retouching, or are deficient in brilliancy, may be treated with a thin coating of good varnish, which increases the gloss of the image and protects it also from moisture. Only care must be taken to employ but such varnishes which can be used very thin and sufficiently hard to withstand scratching. Varnish will be found to adhere far better to pictures of this kind.

It is by no means imperative to employ collodion for the coating of pigmented tissue; there are substitutes on the one hand cheaper, and on the other more easy of application. Indeed, manufacturers have already taken the matter into consideration, and tissues are coming into the market the surface of which is covered with a porous colloid film, which will render the pigmented material especially valuable for employment in hot climates.—*Photographisches Archiv.*

THE ART MANUFACTURES OF JAPAN.*

By CHRISTOPHER DRESSER, Ph. D., F. L. S., &c.

I LEFT Yokohama for Kobe, having spent a month in Tokio in studying the manufactures of that district, and in getting together such part of the representative collection which I had engaged to make as the capital and its surroundings furnished; thus I commenced my journey of nearly two thousand miles in the interior.

JAPANESE POTTERIES.

From Kobe my first excursion was to the island of Owaji, which island I first reached, and then crossed in order to see the potteries which have, for two generations, carried on a sort of independent life in this isolated situation; and here I may mention an experience which serves to show one of the numerous difficulties of dealing with Japanese manufacturers if we call upon them to meet our wants as we expect European manufacturers to meet them.

Seeing a cup and saucer with which I was well pleased at one of the Owaji factories, I asked that two complete tea-services be made for me of that particular pattern, and remarked that if they could get one made so that I could see it before I left the district, I would then, should it be satisfactorily manufactured, order others. After many and tedious calculations, with the aid of an abacus (that miserable frame, without which no Japanese trader can tell you the price of a penny toy), the manufacturer stated that he thought they could get the two services made in two years. In vain did I try to induce the owner of the factory to employ further assistance. "How," he said, "can I know that the work of other artists will please you?" and my warmest assertions that if he were satisfied I should be pleased availed nothing, and I left him with the promise that in two years I should receive two services. Upon returning to the mainland I started for Sanda, where celadon, or sage-green wares, have for many years been made. It is an undying, mountainous district, in which I found small potteries loosely scattered over a considerable area. Next I went to the sacred city of Nara, then to Osaka—a great seat of metal and other industries—then to Kioto and Lake Biwa, next along the entire length of the great promontory of Isé, where are situated not only the great Shinto shrines, but also the seats of the leather-paper manufacture. I then went to Nagya, then Wakiyama, then Koya-Zan—this latter being a sacred mountain, on which stands a city, formed of two hundred and forty temples, and which no woman entered for a thousand years prior to the revolution of 1868; and to this hour not even a Japanese can sleep in the city without a special order from the governor of the province. Yet, with the kindness which I ever received while in Japan, I was permitted to tarry with the priests in the sacred apartments of a temple.

To enumerate the various towns that I visited, and districts through which I passed, would occupy the entire evening; and I have mentioned the few just named in order to show you that I had the opportunity of observing the same manufactures in various parts of the country somewhat widely apart, but in all parts the manufacturing processes were similar.

Nothing impressed me so much, as the result of my observations in Japan, as the smallness of everything. The pottery of Owaji was large in comparison with most of the manufactories that I saw, yet it could only turn out one decorated tea-service a year. Generally speaking, one man constitutes the entire manufacturing staff of a factory, or, if he is an old man, the father and son.

THE JAPANESE POTTERS AT WORK.

I visited, while in Japan, sixty-eight potteries, and the most interesting wares were generally made in the following way:—In a lovely little room, the floor of which was covered with mats, dwelt the potter. I may tell you that in a Japanese living-room there is not one particle of furniture—no chair, no table, no cabinet. The floor is covered with thick mats, each of which is six feet by three (their foot and their yard are each of the same length as ours, but the inches are longer, as there are but 10 inches to the foot, and every room in Japan is of the size of a certain number of mats). One mat being removed from the floor, a potter's wheel is exposed to view, but the wheel is of the simplest character, as it is a mere circular stone of the form of a Cheshire cheese, level with the uncovered floor, and working on a vertical axis which is fixed in a log of wood beneath the floor. At one side of the wheel is a clean tray bearing a lump of clay. At the other side is another tray—often well lacquered—on which the vessels, when shaped, are placed. The operator now kneeling in front of the wheel, and sitting more or less back on his heels, sets the disk in motion by whipping it with the tips of his fingers till the necessary speed is attained in its rotations. He now places a piece of clay upon the wheel and gives to it form in the usual manner, stopping to whip the stone whenever it is necessary that its speed be requickened, and in this way he shapes his wares.

Not unfrequently the potter, after removing from the wheel the vessel which he has formed, distorts its shape, substituting quaintness of contour for a symmetrical form, and in the pottery district of Mino I found one man who was known under the cognomen of the funny man, as he invariably gave to his wares eccentricity of character. Few in Japan can afford to burn their own wares, hence a number of potters congregate around a public kiln where their wares are fired at periodical intervals. In many cases, a potter only makes plain wares, when he sells his productions to artists, who not unfrequently reside at great distances from the potteries (nearly all the enamel blue ware is painted in Tokio on vessels made in Seto, about 300 miles distant). In this case the artist usually keeps a stall, or little shop, and paints his wares, and attends to customers, as necessary. Such a man fires his own paintings in a kiln about 18 inches high, and 15 inches in diameter, the kiln being circular and having a domed top.

Having painted a sufficient number of pieces the kiln is charged, and the small charcoal fire by which it is to be heated is lit; but the potter not only lights the fire of his kiln but he also lights his pipe, and this he recharges about every three minutes, for it is very small; he now sits the very picture of happiness, till his wares are fired. In this way things are managed in Japan, and while there are potteries with more pretentiousness to be found they are of rare occurrence, and where anything approaching European ideas has been adopted, excellence of execution is replaced by slovenliness, and the desire for gain supplants love of the work. Yet there are factories in which quantities of household vessels are made.

*A paper recently read before the Society of Arts, London.

CURIOUS MODE OF MAKING SCARFS.

I visited a town which was devoted to the production of curious scarfs and fabrics; and formerly the productions of this district were of the highest merit and interest. Here are some of these scarfs, and in this way they are made. Two pieces of white silk crape are taken, each of which is about three yards in length and twelve inches in width (twelve inches is the usual width of native cloths). These two pieces of fabric are placed together so that one is exactly over the other; thus placed we will regard them as forming one double fabric, and will forget that there are two thicknesses, for they are both treated as one, and the two are manipulated together, so as to effect a saving of labor. A small piece of pointed stick, resembling a common meat skewer, and a quantity of waxed thread, are the requisites of the process.

From below a small portion of the fabric is pressed upwards on the point of the skewer into the form of a little cone of, say, half an inch in height—a cone which is kept in form by the waxed string being wrapped around it; the skewer is now withdrawn and removed about half an inch from this little tuft, when it is employed to raised a second cone, which in its turn is wrapped round by the waxed thread. This formation of little tufts is repeated till the entire fabric is covered with them, when it is ready for dyeing. Thus prepared, the fabric is taken to a dye vat (a vat which in this case generally contains scarlet or pink coloring matter), and here it is dipped. The action of the dye is, at the same time, to give color to the cloth and to shrink it, hence where the dye has come in contact with the crape a shrinking has taken place; thus permanent conical eminences are formed. The wax thread is now removed, each little tuft being unwound, and not only has a curious fabric been formed, with a surface consisting of conical eminences, but also a fabric which is variegated in color, for where the wax thread was in contact with the crape the dye could not act upon it; thus, by the one operation a fabric is produced both variegated and of a rich coarsely granulated character.

These scarfs were, when single, worth about one pound sterling each. They were then such as any lady in the land might covet; but to ourselves in part, and still more to the Americans, attaches the blame of bringing comparative ruin to the town where they were made, and of destroying a lovely manufacture. "I will give you 18s. each for them." "I will give you 15s." "I will give you 12s.," and so on. This is what the consecutive foreign merchants said, till the last gave about 3d. Let me show you what this lovely manufacture has degenerated to; and these miserable fabrics are the best that can now be procured at the town where once only beautiful objects were made.

We talk, your Excellency, of the degeneracy of Japanese manufactures, but who is the cause of this sad falling off in the quality of their productions, and we wonder whether Japan can now produce what it did prior to the overthrow of the Shogoon's rule? I am happy to tell you that Japanese arts are not yet lost, and that Japanese love of the beautiful has not been stifled, for in all cases where I offered remunerative prices I got the old thing with its beauties and strange merits. But as we are thus destroying the beautiful arts of a people saturated with the refinements which spring only from an old civilization, can we wonder at that dislike to the foreigner which permeates so much of Japanese society? I do not; and were I a Japanese I should hate the foreigner with a sincere and unmitigated hatred.

This process of tying the cloth into knots is used as a means of placing a spot, or curious pattern on fabrics, not only in Japan, but also in India, and the silk pocket handkerchiefs which were in common use by gentlemen about thirty years since, were spotted in this way. Here is a specimen from India showing the nature of the process.

HOW THE JAPANESE PRINT ON CLOTH.

While speaking of fabrics, let me try to describe to you various processes which I witnessed in one of the largest print-producing establishments in Japan; and what struck me as remarkable here was that most processes consisted in the combination of hand work and of mechanical methods.

First, I saw blocks which worked in pairs: the one was simply a heavy piece of wood with a perfectly smooth surface, the other had the pattern which was to be placed on the cloth cut into it; thus the figured block had the pattern wrought in intaglio upon it. From the deeper portions of the intaglio figure holes were bored through the block to its outer surface, where they were enlarged into funnel-shaped tubes.

In order that the fabric be figured, it is stretched over the plain block which has its smooth side upwards. Upon this lower block the figured block is inverted, hence the fabric lies between the smooth surface of the plain block and the figured surface of the upper block. Pressure is now employed so as to bring the surfaces of the two blocks as near to each other as possible, and a dye is poured down the funnel shaped holes and thus comes in contact with the fabric wherever the block is engraved. When the fabric has become saturated with the dye the blocks, while still in close contact, are inverted, so that the surplus dye is poured off, and the fabric has received its pattern; for the pressure has been sufficient to prevent the "running" of the dyes, and thus the disfigurement of the fabric. We, in our own calico print works, employ a process similar to this.

The next process was that of placing a pattern upon the cloth by simply stenciling the pattern instead of printing it, the stencil plates being formed of paper rendered non-absorbent by oil or some similar body, probably by Japanese lacquer. But of this process there are two methods, for in certain cases the pattern is stenciled in the ordinary manner, a dye being used as we use paint; in the other a "resist" is stenciled on the cloth, and the entire fabric is afterwards immersed in the dye-vat, when it becomes dyed in every part save that which was protected by the "resist." "Resist" may be starch or gum, or any material that will cover up the surface of the cloth and prevent a dye-stuff from coming in contact with it.

Another process consists in reversing the common operation of stenciling; thus in ordinary cases if we wished to stencil a leaf in red upon a white ground we should cut from a sheet of paper a leaf of the shape desired, when we should have a hole in the paper from which we cut it of the same shape as the leaf cut out. In this case, we should use the sheet of paper from which the leaf had been cut, and by dabbing our red color through this hole should get a copy of the leaf in red. But the method to which I now wish to draw your attention consists in using the leaf-like bit of paper which has been cut from the sheet, and placing it on the cloth, and spreading over it, and that portion of the cloth which surrounds it, by the agency of a sort of trowel, a paste-like "resist." This done, the leaf-shaped piece of paper is picked up from the fabric, together with that portion of the resist that covers it, by the agency of a point, or pin, and thus the fabric is left exposed where the paper leaf was. As many leaves as are desired are placed over the fabric, and the whole is covered with resist; the various leaves are now picked out and removed, and upon the resist becoming dry, the fabric is immersed in a dye, when the exposed parts—the leaves—acquire a color, say red. This operation being completed, the resist is removed from the cloth by the action of water, and we have red leaves on a white ground.

JAPANESE PROCESS FOR THE ORNAMENTATION OF SILK.

Now I have to describe to you the process by which the more expensive fabrics receive figures, and I hope that I may make myself understood; but, as the process is difficult to describe, and as we, so far as I know, have no analogous process, I fear that I may fail in making the method of manufacture clear to you.

First, the fabric (always silk, I believe) is given to an artist, who draws the pattern upon it as carefully as if he were designing an historical cartoon. The pieces of fabric are about 40 ft. in length, and 12 ins. in width, and on the entire piece the artist either places a varying or a repeating pattern, as may be desired. This pattern he draws with a preparation of indigo, which can readily be removed from the fabric by washing; and he not only gives outline, but also carefully adds depth, or shade, or whatever may enable him to produce a desired effect.

Thus, at the outset, the whole pattern is drawn by hand, and this we should think a sufficiently costly mode of producing a pattern; but in the process which we are considering, the work is only now in its first stage of development.

The artist hands the fabric to a workman who has prepared for himself a material of the most tenacious and ductile character—a sort of glutinous bird-lime. This mucous matter he forms by boiling the finest possible rice flour with lime water of a particular strength. Having previously prepared his glutinous matter he warms it slightly and rubs it on a board with a sort of putty knife; but it appears to me as difficult to rub as warm india-rubber would be. A piece of this bird-lime about the size of a small pea is placed on the end of a wooden point, or skewer, and a portion of the fabric is stretched flat by bent pieces of cane; thus all is ready for work.

Holding the frame over a small charcoal fire, and with one hand (the left) under the fabric, so as to raise any portion of it, and with the point of wood, on which is the little ball of plastic matter, in the other hand, the operator commences his work by touching the fabric at some point of the pattern, say at the base of a leaf, with the mucous ball, which at once adheres to the cloth. The ball of mucus is now drawn to some little distance from the surface of the fabric, say a foot, but between the fabric and the ball there now intervenes a thread of this mucus, for so ductile is the material, and so sticky that it will adhere to anything, and draw out to a thread some yards in length without breaking.

By certain dexterous movements of the right hand, in which the wooden point by which the plastic matter is supported is held, and by the middle finger of the left hand raising the cloth when necessary, a thread is constantly being formed of the plastic matter, and is as constantly dropped upon the fabric as an outline to the pattern. With the utmost skill leaves, flowers, and even the small parts of the flowers, as the stamens, are outlined with this mucus, which falls upon the cloth as a thread of about the thickness of an ordinary pin-shank. The whole pattern, however small its detail, or however finely serrated its leaves, is outlined in this manner.

But as this outline is not sufficient, means are adopted for thickening it, hence a conical tube of oiled paper is formed of about four inches in length, and with an orifice at the broad end of about an inch. At the small end this tube terminates in a tin nozzle, in the apex of which is an opening such as would be made by a darning needle. This tube is charged with the mucus, and through the fine opening in the tin nozzle the plastic matter is pressed in such a manner as to thicken on the outside, and also to raise, the outline already formed. All this has afforded a means of preventing the "running" of dyes which are now to be used, and when thus prepared the fabric is ready for the next stage of the process.

This consists in the painting, with dyes of various colors, of the spaces inclosed by the little bank of the now dry, but formerly mucous, material, and a care is bestowed upon this painting, such as if a highly-finished water-color drawing were being produced. In this way the pattern is wrought. The dyes having dried, the colors are exposed for about six minutes to the action of steam in a steam bath (which is a sort of kitchen "steamer," placed over a pot of boiling water), and then the mucous matter is removed by the fabric being gently rinsed in a vat of clean water.

If it is desired that the ground be colored, the whole of the pattern is now painted over by a "resist," and the fabric is then dipped in the dye vat, the ground receiving its color, as it is unprotected.

Many fabrics are made by combinations of these processes, as I have already said. Thus, some are in part stenciled, and in part wrought by this last-mentioned method. To me it appears that the means of producing an effect which I have just described is the most laborious of any that I have known, but while it is a laborious means of achieving an end, the result gained is in the highest degree satisfactory, for what could be more delicious than parts of these fabrics?

JAPANESE WEAVING.

Before we leave the consideration of the means by which fabrics receive their figure, or pattern, I will just say a word on the loom, as some of the Japanese brocades which receive their pattern by the loom are unsurpassed in beauty by any fabrics in the world.

I was taken to a factory which now receives a government subsidy by the Mayor of Kioto, and here there were, perhaps, twenty looms weaving the richest of tissues. In some of the looms eight or ten shuttles were employed, each carrying gold or some bright colored silk. Now the Jacquard apparatus, if I may term it such, by which figure was given to the fabric, consisted of a youth of about seventeen summers, who, perched on a beam near the ceiling of the weaving-shed, gathered up the harness as necessary, and when all was collected, lifted it up and shouted to the weaver below to throw the shuttle across. This process of collecting the harness was gone through between every throw of the shuttle, and in this laborious manner the exquisite brocades of Japan are produced.

In the same shed with these primitive looms stood the newest Lyons loom with its perforated cards, and even the

newest card-stamping machine, but the work produced by this latter was not comparable in beauty with that wrought by the more simple native contrivance.

I must now leave the consideration of fabrics, but to what shall we turn, for the manufactures of Japan are as varied as they are interesting?

HOW FINE JAPANESE FANS ARE MADE.

Here is a fan, or screen, which I bought in the lovely old city of Nara; it, like most of the fans made in this district, is perforated, and it is not only perforated but is formed of silk; some of these fans, are, however, made of paper.

I observed the process by which these fans are made, and the perforation of the silk, or paper, is achieved simply by hand. Six thicknesses of the material are placed one above the other, whether it be paper or silk, and through the six thicknesses the perforations are at the one time cut by a knife; and however fine or intricate the pattern, and however large the order that has to be executed, six thicknesses only are cut at a time, and the cutting is entirely by hand.

JAPANESE METHOD OF PREPARING MOULDS FOR ORNAMENTAL CASTINGS FOR VESSELS, BRONZES, ETC.

Shall we now visit the metal-workers, and see how they conduct their manufactures, for what we shall here see is as remarkable as the means by which fabrics are figured?

This kettle is characteristic of what is in general use in Japan. I sincerely wish that it was characteristic of the kettles in general use in England. It is an object of pleasant form which is covered with conical protrusions having a geometrical arrangement. While the eminences by which the heating surface is so ingeniously increased are very numerous, and while they are so accurately disposed upon the surface that we can scarcely detect the slightest displacement of any one dot, they are yet the result of hand labor. A hollow mould which is to give form to the outer surface of the kettle is made of sand, but it is yet smooth, and has been shaped on a block of wood of the required form. The mould-maker now takes a small bar of iron, about three inches in length, with an end so formed as to represent exactly one of the eminences which he wishes to have on the sides of the kettle. With this he makes depressions in the mould, which has up to this time been smooth, and the positions of the depressions which he makes, and the degree of their depth (depressions which, when the pot is cast, will become eminences) he determines by eye, without the aid of any measurements whatever.

It is not uncommon to find Japanese bronzes, and even iron pots, with flowers, or birds, or a dragon in almost full relief upon them The casting of such objects by us would be accomplished by "piece moulds," and casting by piece moulds is always expensive; but the Japanese will cast a chrysanthemum, with its numerous juxtaposed petals, as perfectly as a more simple ornament, and such a casting no piece-mould could enable us to produce.

Whatever is to be cast is modeled in wax: if a flower is to protrude in almost full relief from the sides of a pot, it is first modeled in wax. It is then attached to a wooden block of simple form, such as would, if the wax flower were not attached to it, drop from the sand were it used for the formation of a mould.

The model, consisting partly of wood and partly of wax, being ready is carefully brushed over with a pulp formed of sandy clay. When this is dry, a second coating is given of a pulp containing more sand, and perhaps a third and a fourth. When these are dry, sand is piled up around the mass and pressed into the interstices between the parts, but these are already largely filled by the previous applications of semi-fluid matter. When sufficient sand has been pressed around the model to form a solid mould the mass is taken to a sort of kiln or muffle and is there exposed to a degree of heat sufficient to melt out all the wax, which first becomes absorbed by the sand, and then dissipated as gas from the mould. The wax of which I am speaking is not wax simply, but a mixture of wax and resin. The mould is now prepared, but I did not see the actual casting.

One of the largest bronze manufacturers in Tokio kindly offered to give up a day in order to show me the entire process, but I was, unfortunately, so occupied that I could not avail myself of his kindness. I was, however, told that the moulds were warmed before the casting was made, so that the metal might not be chilled while running along the smaller channels of the mould, and this, I think, very likely, but as all my information had to be gathered through interpreters great difficulties were experienced, for in some instances excellent interpreters do not happen to know the technical terms which belong to special trades and manufactures. For the interesting castings now before us I am indebted to Messrs. Jackson & Graham.

If a thousand vases had to be cast, each with a flower in relief on the side, and if each vase was to be of precisely the same pattern, a separate model would yet be prepared for the casting of each, and the same labor would be expended in producing every one that was expended on the production of the first.

I have spoken of the difficulty of gathering information through an interpreter: with the view of illustrating this statement I will give you one example. When viewing the enormous bronze figure of Daibutz (Buddha) at Kamakura, together with Mr. Mountsey, who had kindly taken the chief native interpreter from the embassy at Tokio with him in order that I got the fullest possible information respecting what we might see, I observed two large metal loops jutting out from the back of the figure near the scapulæ or shoulder blades, and asked what purpose these served, as I could see no use for them. The immediate reply was, "For the shine, for the shine;" I confess that I was puzzled, and after making many guesses at his meaning gave up all attempts at discovering the purport of his remarks.

By the roadside, as we journeyed homewards, was a celebrated Buddhist temple which we stopped to see, and in it were many images with nimbi. No sooner had our interpreter caught sight of a nimbus than he exclaimed, "The shine, the shine," when we at once discovered the use of the loops on the back of the great Daibutz, which were fixings for the nimbus, and wondered at our ignorance, for have we not the word "shining," which is akin to "glory?"

While speaking of interpreters, I would take the opportunity of mentioning the fact that the gentleman, Mr. Sakata, or, as they would say, Sakata San, who was appointed by the government as one of my escorts through Japan, and who acted as my interpreter during my long journey in the interior, scarcely ever failed rightly to render even technical terms. Without doubt he was the most skilled interpreter that I ever met with, and he was also a most charming gentleman and companion.

I had hoped to have told you how that wonderful process of enameling on earthenware is managed, for while we know how to make cloisonné enamel work on metal (Messrs. Cristoffle, of Paris, having sent a man to China to acquire the art and we getting it from him), the manufacture of cloisonné on earthenware is an art peculiar to Japan. I have, however, seen the whole process, and through the kindness of Dr. Raretz, of Nagoya, am possessed of illustrations of the manufacture in every stage of development, and I have also got samples of every material used in the manufacture, but as I have not yet been able to analyze the various substances, I cannot give you the information which I had hoped to have given you on this occasion, but at this I feel less regret than I otherwise should, for I fear I am almost pledged to write a large work on Japanese processes of manufacture.

THE JAPANESE LACQUER MANUFACTURE.

Perhaps the most characteristic and the most beautiful art of Japan is the lacquer manufacture, for what can be more lovely than some of the specimens I am, through the kindness of Messrs. Jackson & Graham, enabled now to show you? Some of these are very old, and all have merits, while for delicacy of treatment, attention to detail, and exquisite finish, some are unequaled by any works, so far as I know, that any other people have produced. Lacquer is, with the Japanese, an old art. In my judgment its best period was from 600 to 400 years back, and I had every opportunity of judging, for in the Mikado's private collection of antiquities in Kioto—not the collection at Nara of which I before spoke—are many examples with authentic dates. As a manufacture it reached its highest development from about 300 years to 100 years since, but while the workmanship achieved the highest excellence at this period the drawing of the decorations is not so pure and good as at the earlier date; and I was informed by the keeper of the royal collections at Kioto that formerly the patterns were drawn upon the objects by artists and not by lacquer-workers, whereas, during the later period, the lacquer-workers were also the artists.

This old lacquer has now great value. For a box about six inches square I was asked in Japan £100 sterling, and Lady Parks told me that fine specimens were, in Tokio, bringing their weight in gold. Messrs. Jackson & Graham have the good fortune to possess the only considerable collection of old lacquer that is for sale in Europe, and fortunate they indeed are in their possession, for old lacquer is rising in price rapidly and is now almost unknown in Japan. The taste for lacquer work is also setting in among us, and surely no objects are more worthy of admiration than the beautiful works in lacquer which during the last 600 years Japan has produced.

I have here a piece of lacquer which has rarely been equaled, and perhaps never excelled, in its own way. The Japanese are great admirers of cherry blossoms; indeed, they like all flowers that they have to look up to, but the cherry blossom is a special favorite. Here we have the cherry-tree with a profusion of blossoms mingled with young leaves; but it is not to the poetical thought associated in the Japanese mind with the cherry-tree that I would call your attention, nor to the pleasant reminiscences of picnics which have taken place on the cherry-clad hills during the season of the flowers—reminiscences common to all Japanese—but to the simple excellence of the work, whether it be regarded as a mere piece of manufacture or as a work of art.

Nothing could be more perfect than this work is. In drawing it is excellent, in delicacy of treatment most tender, in consistency all that could be desired. Our merchant princes give £1,000 for a painting, or even £5,000, and yet they have up to the present time hesitated to give £200 or £300 for a work so noble and so pure as this. Believe me the time is not far distant when, through better art education, the superior merits of these lovely works will be so fully appreciated that the keenest competition for their possession will take place; indeed, this competition has already set in. And this is certain, that the world can never see many works so lovely as this and others that Messrs. Jackson & Graham have so kindly placed around me, and many are of nearly the same excellence.

I am glad to be able to tell you that at the present moment lacquer wares can be made having the best qualities that lacquer wares ever possessed; but if good, they must be very expensive, even more so than the present prices of the old pieces, for the method of production is most laborious, and the cost of labor has of late years so greatly increased in Japan, that the sum of money that will now buy a poor man one pair of sandals, would ten years since have bought him twenty-seven pairs.

Under the auspices of the Japanese Government a company has been established with the view of redeeming the arts from the corrupting influences of the large European and American demand, and in this company the Hon. Mr. Sano—to whom I am indebted for so many acts of kindness, and for much information, as I before told you—takes a warm interest. This company may do much to maintain the excellence of Japanese manufactures, and I wish it well, but its management must be conducted with care, as I fear that even the Japanese ministers have but an imperfect idea of the enormous demand which Europe makes upon Japan for excellent works. If, however, Japan can produce works of the highest quality in sufficient quantities, Europe certainly can furnish the market for their sale, for we know the excellence of their works and love them.

THE PROCESS OF LACQUER MANUFACTURE.

At to the process of lacquer manufacture. First, a wooden object is prepared, for nearly all lacquer is worked on wood and not on papier-maché as some suppose. If common objects are to be formed small pieces of paper are stuck over any little defects which the wood may present. Then the whole is coated with lacquer. This coating being dry, little roughnesses are rubbed off with a lump of coarse charcoal, and another coat is added, which in its turn is rubbed smooth. Four or five repetitions of this process complete the object, unless it is to be decorated.

If a gold spray is desired on a common vessel it is first drawn in a lacquer, the lacquer being used as a gold size, and when the lacquer is in part dry, gold bronze (powder) is sprinkled upon the drawing, which gold bronze adheres to the wet size.

REMARKABLE QUALITIES OF JAPANESE LACQUER.

What I have said only describes the process of making common lacquer objects, and before I proceed to show how the finer work is produced let me say that lacquer is a thick fluid which often resembles in appearances pale treacle, or what is called golden sirup. I think that it must flow from the vessels of the tree which produces it, for it is more nearly allied to gutta-percha than to a gum resin. It is unhurt by hot water or ordinary acids, resisting alike the action of strong vinegar and boiling water. I find that it will resist the action of boiling acetic acid, and of the strongest caustic potash, hence no ingredients used in cookery could hurt it. It is, when in its fluid state, highly corrosive, for if one solitary drop comes in contact with the skin it produces a wound which generally eats itself through to the bone; even from visiting a lacquer factory some persons take a kind of fever. How it dries, or whether it dries or not, in ordinary air I did not learn, for it is always dried in the factory in a cupboard the interior of which is brushed all over with water every day so as to produce an atmosphere saturated with moisture; in this damp air it dries in from eight to eleven hours.

CURIOUS METHODS OF DECORATING LACQUER WORK.

A good piece of plain (undecorated) lacquer work has already received about eleven coatings of lacquer, and has been carefully ground down after receiving each separate coating. This object being now prepared for decoration a pattern is transferred to it by an outline being made on a piece of paper in lacquer which has been warmed or boiled (this heating having the effect of retarding or preventing its drying). The pattern being thus drawn the paper bearing it is placed face downwards on the object to be decorated and rubbed at the back, when a transfer of the outline to the lacquer surface has been effected just as we copy a letter, or as an engraver takes a proof impression from a wooden "block." The paper is now peeled off and can be used again if it is desired to repeat the pattern, for several transfers can be made from the one drawing.

This done, if the ornament is to have a gold outline, the lines of the transfer are followed by a fine brush containing lacquer which acts as a gold-size, and I noticed that the lacquer used for these outlines dried so rapidly that no sooner was a leaf outlined than the gold powder was dusted upon it. I also observed that the gold used for this best work had the appearance, when shaken upon the work, of a gray powder, and looked rather like an oxide than a pure metal, but when, after adhering to the lacquer, it was rubbed it at once became bright and gold-like.

The variety of surfaces that the lacquer worker achieves appears to be endless. If a solid gold surface is desired, it is produced by a fine gold powder being sprinkled upon, and somewhat rubbed into, a surface which has been covered with wet lacquer. If clouded gold is required it is formed by gold dust being shaken through a reed, which is about four inches in length and the end of which is covered with fine silk. If a colored ornament is required with a clouded gold surface the ornament is first painted in the required color or colors, and upon this color the gold dust is sprinkled. By this means some of the richest effects of lacquer are produced.

On many fine pieces of lacquer we find little squares of gold; these are about the thickness of ordinary writing paper, and are cut from a sheet of gold by a sort of knife. When a quantity has been cut they are placed upon a little tray which is held upon the thumb in the manner that a gilder's pad is held, and from this the little tesseræ are taken one at a time by a pointed skewer of wood which is pressed upon them—the mere pressure causing them to adhere to it—and are placed on the lacquered surface. Over the gold work, however the gold has been applied, if the lacquer ware is anything better than common, from one to several coatings of lacquer are placed according to its excellence; the first is ground off every projection, however small, and remains only between the grains of metal, the rubbing down being most carefully effected by a woman who employs for that purpose a small piece of charcoal. A coating of transparent lacquer is now given, which in its turn is ground down, and then another, till finally the work is polished by the agency of the ash of deer's horn applied with soft leather.

Raised work results from the application, first in a rough form, of lacquer mixed with bone-dust; this is, in all cases, applied by a brush, and is never the result of cutting or carving. When this heaped-up lacquer begins to assume the desired shape, owing to repeated applications, its form is carefully modified by grinding with small lumps, or strips, of charcoal, and for this purpose charcoal of about 20 degrees of hardness is employed. By repeated painting and grinding form is given to the raised parts, which are often truly works in *alto rilievo*, and when brought to their shape they are colored, painted, or dusted with gold, as the case may require.

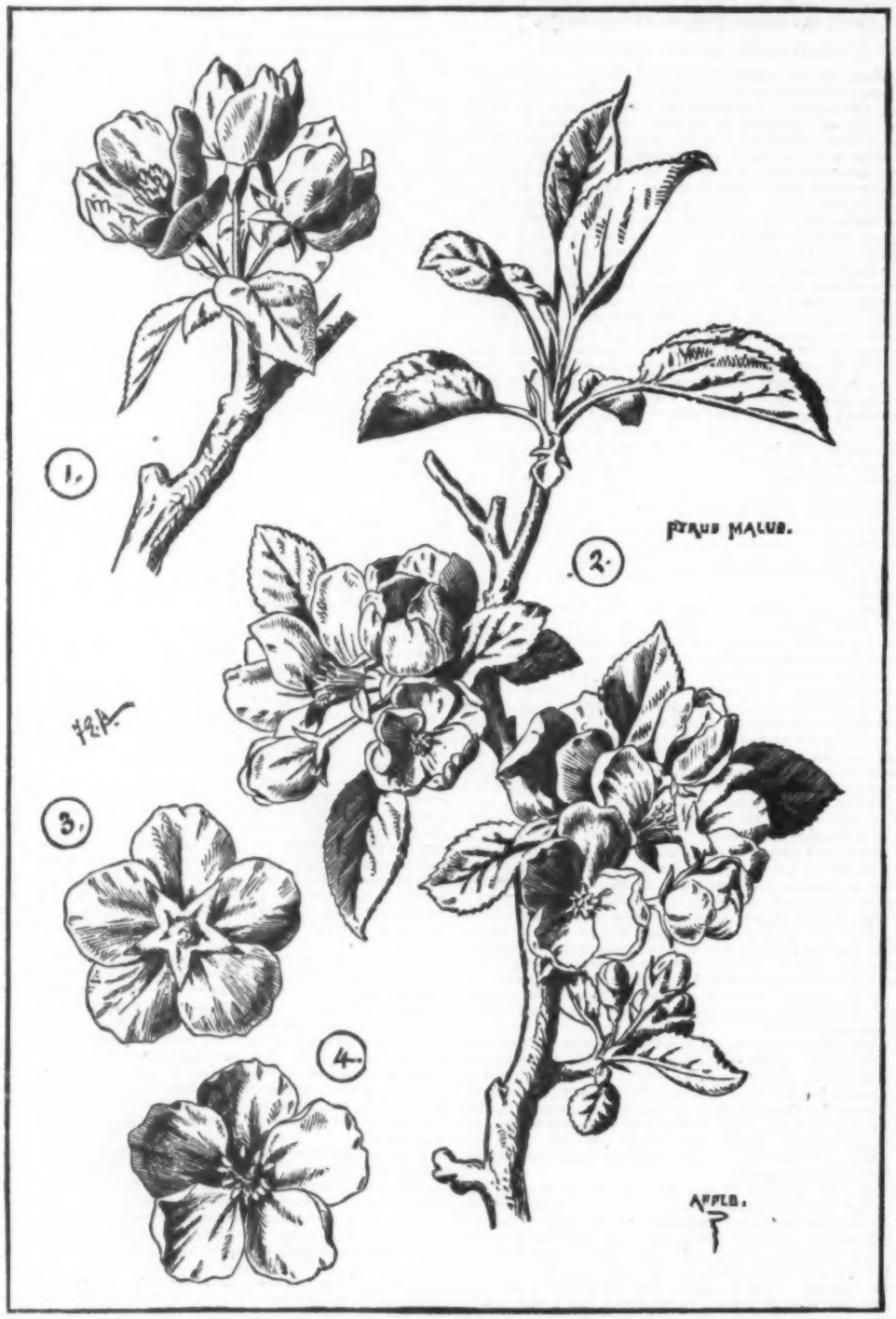
I could say more on lacquer work; and I have mentioned only a few of the manufactures of Japan, but I have exhausted my time and your patience, I fear; yet I cannot close without making one remark, which is this, that while the art processes of Japan are such as render the production of quantity impossible, if excellence is to be attained, they yet secure the highest degree of art merit. I have watched the poor artisan laboring at his work with an earnestness and love such as I never beheld out of Japan, and the very features of the workmen testify to their happiness, and to the love with which they perform their pains-taking labor. No thought of gain appears to enter their minds, and no touch is spared which will make the work more lovely; this is how the beautiful works which we delight to look upon are produced. They are works born of loving labor; they are the children of happy contented men who love their labor as they love their lives, and who, separated from the former, would part with the latter. How different are these from our workmen! The one supremely happy, the other always unhappy, for he who seeks to do the least work possible for the largest amount of gain can never know peace; the one perfectly contented with the simplest of fare, the other always craving after more while yet well fed. If our workmen could but see the dear old men of Japan engaged in their various handicrafts they could not fail to learn that happiness is not found in short hours and high pay, but in the love of our work. And this is the reward which these poor men receive—perfect happiness! The Japanese handicraftsman, owing to his happiness, content, and skill, have the friendship and patronage of the lords of the land (the Daimios), who will converse with them and receive them at their palaces, while no merely moneyed man—even the richest of merchants—has any status in Japanese society; but we must ever remember that through his virtues the workman has made himself worthy of the friendship of his lord, and a fitting companion for him.

ETCHING FLUID.—A German contemporary recommends etching with a preparation of 250 grammes of perchloride of iron, which is allowed to slowly decompose in half a liter of water. The advantage of this preparation is said to be that it has an effect on metals of all sorts without giving off noxious vapors. The object will need constant cleaning with a brush. The solution is rectified with oxide of iron when choked with metal; the etched ground is cleaned with turpentine.

SUGGESTIONS IN DECORATIVE ART.

THE APPLE.

THOUGH unfortunately the lack of color must perforce deprive us of one of its greatest beauties—the delicate tints of the apple blossom—the drawing will nevertheless give the designer a good deal of the detail of the plant. Though we miss the delicate streakings of pink on the snow-white petals, and the delicate grays that give the shade tints of these beautiful but fragile-looking blossoms, and the tender green of the foliage, all the forms are given—the bosses of



SUGGESTIONS IN DECORATIVE ART.—THE APPLE.

blossom that succeed each other with such rich profusion on the stems, and the vigorous outspringing of the leaves so recently burst, under the genial influence of spring, from the bud in which they have so carefully been wrapped and preserved amid the cold winds and nipping frosts of winter. The colors of the apple blossom are so attractive a feature that its use where this feature can be rendered, as in chintzes, wall-papers, and pottery-painting, would be clearly an advantage. Our illustrations probably tell their own story. The first two are natural growths, giving the quaint crumpled look of the opening flowers, the form in which they are massed, and the way the foliage springs from certain points on the stems, while Nos. 3 and 4 are back and front views respectively of a fully expanded blossom. As the tree in its flowering state is an especially beautiful feature in the spring flora, it might very well be employed by the designer as typical of that season. We have ourselves employed it as one of a series of twelve floral designs illustrative of the months, and we may further be allowed to add that we have in our "Familiar Wild Flowers" given a colored drawing that will probably be of service to the designer, for, though the subject there illustrated is the wild apple of the hedgerow, the colors of the wildling and the garden species are identical, though the forms of the latter are naturally fuller and richer, the result of cultivation.—F. E. H., *in Building News.*

THE trade mottoes of some of the London associations are curious. The blacksmiths, for instance, have "By hammer and hand all arts do stand;" the distillers, "Drop as rain, distill as dew;" the founders, "God the only founder;" the inn holders, "Come, ye blessed: when I was harborless, ye lodged me;" the joiners, "Join loyalty and liberty;" the saddlers, "Hold fast, sit sure;" the weavers, "Weave truth with trust," and the needle makers, "They sewed leaves together and made themselves aprons."

CLEANING ENGRAVINGS.—Put the engraving on a smooth board; cover it thinly with common salt finely powdered; squeeze lemon juice upon the salt, so as to dissolve a considerable portion of it; elevate one end of the board, so that it may form an angle of about 45° or 50° with the horizon. Pour on the engraving boiling water from a tea-kettle until the salt and lemon juice be all washed off; the engraving will then be perfectly clean and free from stains. It must be dried on the board, or on some smooth surface, gradually. If dried by the fire or sun, it will be tinged with a yellow color.

AROMA OF BUTTER.

F. TRACHSEL writes to the *Chemical News* that in many parts of Switzerland, noted for their good milk and superior butter, a simple and, I think, a valuable method of not only bestowing a fine aroma, but of removing any *gouty* or *sweaty* odor from the milk, is in regular use there. The milk, as soon as it is drawn and while warm, is filtered through a sprig of washed fir-tips, the stem inserted loosely and upright into the hole of a funnel. The milk being poured on this bunch of clean spicular leaves, deposits hairs, skins, clots, or gelatinous sliminess, as the case may be, on the little spikes. A fresh sprig is used at each milking. The milk that drains is clean, and especially of a fresh flavor, or so slightly aromatized as to retain no unpleasant resinous odor; but becoming as it were "cured," it does not turn sour as soon as milk strained through wire-gauze. Horse-hair strainers are difficult to keep sweet; they often propagate decay by the film of animal matter which they retain, especially close to the joints of the wood. No insects are ever found in fir-tips, while *Asperula* and many other herbs occasionally abound in them, and they cannot be used in winter except in the dry state, when their odors are mostly gone. The fir-tips are rinsed only to remove dust; they are obtainable fresh even during winter, as the fir is an evergreen.

MEDICAL NOTES IN SIAM, CHINA AND JAPAN.*

By C. W. VROOMAN, M.D., Brooklyn, N. Y.

THE history of medical science is correlative with the history of civilization. In all ages of the world and in all nations there have been those who have practiced the healing art. The tendency of life is toward maturity and death. Perhaps the reason which impels men to seek medical assistance is not so much the desire to avert this final consummation as to seek relief from the distress and pain through which the body so often arrives at its dissolution. So universal are the causes which operate against man's physical well being, that there has ever been felt the necessity of a class of men whose function it is to minister to him under certain conditions, to relieve his sufferings, and endeavor to prolong his life. An intelligent appreciation of the laws of health and of the processes through which the body withstands opposing elements, accommodates itself to varying conditions, or renews its vital energy, is now considered an essential part of the science of our profession. But primarily the knowledge considered essential, in fact the whole substance of medical science, was that of the means which might be employed under certain conditions of disease to assist in restoring the body to health again. This knowledge was not gained by the physical study of the human body in its physiology and pathology, or by processes of reasoning, but by accidental discoveries of the effect of certain agents through empirical means. I do not underrate the great benefit to mankind which has resulted from the latter method, for it has necessarily been the source of much of that knowledge which is available at the bedside of the patient. That, however, which characterizes our medical science and renders it so far superior to the empiricism of ancient and mediæval times or of the present day among uncivilized nations is that we have not failed to search out the causes of disease or to put into application our knowledge of the laws of health. Our methods of investigation and research are such that many useless or absurd theories which have encumbered the profession have been eliminated, and this process of elimination now going on is gradually reducing the knowledge as it accumulates into scientific form.

A brief examination into the condition of medicine as it is practiced among some of the different nations of Asia may not be an unprofitable task. The growth of medical science has been correlative with the increase of civilization, and by looking at the different degrees of medical science and skill that now exist in these different nations we may see in them the counterparts of the various stages of European medical science in the different periods of its history, and may trace in this way the rise and accumulation of our own knowledge on medical subjects.

On the northern borders of Siam, along the banks of the Great Me-kong or Cambodia river, and close upon the frontiers of China, there dwells a tribe of people whose name is almost unknown in our own land and whose history is buried in the deepest obscurity. I refer to the Kamoocks. This strange people, numbering somewhere about one million of souls, are scattered over a wide extent of country. In going through their territory the traveler will see their houses upon the mountain tops, surrounded by little patches of cleared land which they cultivate, the whole presenting quite a picturesque appearance in the midst of the dense profusion of vegetative growth which adorns the landscape of that tropical land. I select this tribe among the numerous tribes of people which inhabit that country because it represents the lowest grade of civilization which it has been my fortune to see during my sojourn in the East. But little is known concerning the habits and customs of this people. Probably not more than a dozen white men have ever visited them at their homes, and none have ever studied their language or dwelt among them. By the other occupants of that country they are regarded as the original inhabitants, and for many centuries they have preserved their national individuality, just as the Indians have done to a less extent in our own land. Their manners are rude and simple, and their habits of living primitive to the last degree. Through an interpreter I learned something of their theory and practice of medicine. Disease is by them regarded as the infliction of an offended spirit. Their religious faith is purely Shamanism, and fitting into this gloomy, fearful system of superstition is their spiritualistic ideas of the nature of disease and its origin. There is believed to be but one cause for all the suffering and misery which afflict their race. If any person is sick it is the manifestation of the anger of an offended spirit, who must be appeased before the patient may recover. And so there are those among them who pretend to hold communion with the unknown and unseen things of the air and to interpret their wishes. An animal is slaughtered and its blood poured out as an offering of appeasement. In proportion to the severity and duration of the disease more and more valuable animals are offered up to appease the dreaded spirits whom they suppose are afflicting the patient from vindictive motives. Similar to this may have been the wild, rude notions in regard to disease which our Saxon or Celtic forefathers entertained ages ago, before the first dawn of civilization was brought to them by their Roman conquerors—a fit counterpart to their dreadful system of Druidical worship. Of course multitudes of these Kamoocks perish from disease who might be saved by proper medical care and treatment. During the rainy season they are exposed to a malaria as fatal as that of the Campagna, and the race, now slowly decreasing, will probably in time become extinct.

Occupying a portion of the same country are the more civilized tribes who bear in our works on geography the name of Laos. Like the Indians of our own land, they possess a degree of empirical knowledge in regard to medical subjects. Among them we find a mixed theory concerning the causes of disease. Here, too, the idea that sickness is caused by offended spirits has a certain hold on the minds of the people. But the Laos are one step in advance of the Kamoocks. Among them there is a certain class of persons whose special function it is to take the professional management of the sick, to give medicines, and to indicate the means by which recovery may be effected. The man or doctor here finds a distinctive calling, but small is his knowledge and limited his resources. All his knowledge of the healing art is traditional, and finds its sole expression in the oral teachings of the craft. No books embody the resources of the profession. The monastery is the school of medicine, and the teachers of this science are the bonzes, wrongly called the priesthood of the Buddhist Church. It was my fortune while abroad to reside for nearly a year close by the house of a native doctor. He, like all his fraternity, had spent some time in a monastery wearing the robes and engaging in the religious services of the order. Day

* Read recently before the Kings Co., N. Y., Medical Society.

after day we could hear his incantations, continued in many instances for several hours at a time over one patient, preparatory to binding the wrists and invoking the favor of the spirits through whose malign influence the health of the patient had been impaired. Devotional or expiatory offerings at some of their numerous shrines constitute invariably a part of the treatment of the sick; nor is it a mere ceremony, a dead form, for it fits closely into a living belief among them that disease is caused by the displeasure of offended beings who inhabit the air and who hold in their hands the power of doing much mischief. Their treatment of the sick does not, however, solely consist in endeavors to appease the supernal powers, as among the Kamoocks. Medicines are given, medicines derived principally from the vegetable kingdom, but also in part from the animal and the mineral. Such skill as the Indians of our Western country have, the Laos possess in the empirical treatment of disease by means of medicine.

The Siamese practice, though abounding in absurdities and based to a great extent on superstitions as gross as those which prevail among their more uncivilized neighbors on the north, is nevertheless an improvement on that which I have briefly noticed. Here we find a medical literature, books which are devoted to the description of symptoms and the treatment of diseases. Nor are they free from those absurd theories which have obtained such credit among the ignorant in all countries, theories respecting the cause and nature of disease. Some of these, which are more amusing than instructive, I will briefly mention here: Headache is said to be caused by a wind which blows upward in the body. Rheumatism affecting the lower joints of the body is thought, on the other hand, to be caused by a wind which blows downward; anasarca by a stagnation of the wind; fever by an internal fire which feeds on the body and laps up its fluids. We find also among the Siamese more or less of those superstitious ideas which prevail to a greater extent among the Laos, and which are found in all Eastern countries, in reference to the malign influence of spirits upon the health of persons who may have fallen under their displeasure. In this respect the Siamese practice fits into that of the Laos, though with their increased facilities for knowledge and better civilization it is in advance of the Laos, just as the Laos is superior to and yet fits into that of the Kamoocks. The distinguishing characteristic of the Siamese practice of medicine, however, is in the greater attention given to the various and minute symptoms of disease. In its symptomatology the Siamese school closely resembles that of the early school of Hahnemann. Every minute sensation, every change of mood or feeling manifesting itself during the sickness of a patient is noted with rigid and minute fidelity, and each different sensation forms the basis of a change of treatment. Some new herb or root or bark or leaf, the bones or skin or other parts of some new animal must enter into the composition of the medicine to be administered for every new symptom that arises. According to the number of aches or other disagreeable sensations complained of by the patient does the doctor multiply the ingredients of his mixture. In this way it occurs that the nauseous doses are not homeopathic, much to the disgust of those who are obliged to swallow them. Substances drawn from the animal, vegetable or mineral kingdom, often exceeding in number those contained in an old English prescription, which was composed of over one hundred different articles, are thrown together in a common receptacle, and allowed to steep for hours in water or perhaps in samshoo, an ardent spirit distilled from rice, of which they are but too fond. One or two quarts, or even more, of this formidable decoction is given to the patient at a dose. If the patient does not recover, the explanation made by the doctor and received in good faith is that he has not been able to contain a sufficient quantity of the remedy. It is needless to mention that the mortality of that country is great, the average length of human life there probably not being more than 20 or 25 years. I avail myself of this opportunity to speak of a very curious custom prevailing in Siam, and so far as I can ascertain peculiar to that country. It is in reference to the management of women after their confinement. Labor is accomplished without interference or without assistance, consequently many women perish with their offspring who might be saved by skillful attendance. Nothing whatever is done by them in cases of abnormal labor, as in shoulder presentations, placenta prævia, etc., when prompt action by us is considered necessary. After the birth of the child the cord is severed with a large dull wooden knife made of bamboo. No ligature is placed on the cord to prevent hemorrhage, nor does bleeding often occur, owing to the manner in which the cord is divided. A flat piece of wood is placed underneath the cord, which is then rolled and bruised into by means of the wooden knife. The child is then turned over to the attendants, who feed it immediately on a certain variety of banana, I presume on the same principle that some nurses in this country give a colic-engendering compound of butter and molasses or something of a similar nature to the newly born infants. From this time forth the young Siamese children are to share with their seniors in the contents of the rice bowl, drawing also, till two years or more of age, on their mothers for nourishment. Of course the most of them lose their hold of life in fighting the many adverse influences with which they have to contend, and only the most hardy of the race survive. That, however, to which I wish to call especial attention is the treatment of the mother after labor. She is not, as by us, enjoined to keep the horizonal position for a few days, but may, and does often, rise from her bed immediately after her labor is finished. There is, however, reserved for her a more severe ordeal than that through which she has already passed. During the greater part of one month she is condemned to remain on her couch, rising only to attend to the ordinary calls of nature, and throughout that time, day and night, her naked back is exposed to a hot blazing fire, which is kept burning within a very short distance from her body. I have frequently seen backs which have been scarred and shriveled by this cruel process. Many lives are sacrificed by this pernicious custom, and yet so tenacious are they to the observance of it that not even the late King, the most arbitrary of absolute despots, had sufficient authority to prevent it in his own harem. At the confinement of Her Majesty the Queen-Consort the usual firing was ordered by her native attendants, and it was pitiable to witness the helpless agony of the King, who, being more intelligent than his fellow countrymen, appreciated the commonsense arguments of Dr. Bradley, the American physician residing in Bangkok, backed by the evident failure of the strength of Her Majesty, while he acknowledged his inability to resist the exponents of this ancient and established custom of the people. Not even her death, which occurred, I think, before the month was completed, and which was admitted to be the direct result of the severity of this process, was sufficient to lessen the tenacity with which the people cling to this cruel and barbarous custom. It is believed that no woman can make a proper recovery unless she lies before the fire for the prescribed time, and they experience the same reluctance about omitting it that physicians of our own country did fifty years ago about allowing ice-water in fever or omitting to use the lancet in cases of pneumonia.

Before leaving this subject of Siamese medical practice I desire to call your attention to a medicine which has been used by many of the European physicians residing in the East for several years, and which has, I believe, been introduced to the attention of London physicians within a short time by a man of excellent scientific attainments, Dr. James Campbell, late surgeon to the British Consulate at Bangkok. It is the root of an herb which grows abundantly throughout Siam. I regret that I cannot give its botanical name or classification. The qualities of this root in the treatment of certain chronic diseases of the skin which are very prevalent in Siam, as pityriasis, versicolor, and other forms of erythema, eczema, tinea, etc., were first communicated to Dr. Bradley by the physician to His late Majesty of Siam, who, by the way, was himself of royal birth and a half brother of the King. An extract from this root has proved to be almost a specific for the diseases mentioned above. Mr. Nacken, of Fuh-wing, China, reports that it "has proved unfailing in all cases" occurring in his practice, and in my own experience with it in Siam I was never disappointed. Dr. Bradley, to whom belongs the credit of its introduction to the profession, testified to its value long after he had proclaimed his want of confidence in all except two or three articles of our Pharmacopœia. An infusion of this root is applied as a wash to the affected part, while it is also administered internally in severe cases.

We now turn from Siam to make a brief review of the condition of medical science in China. This is the land of an ancient civilization. Until two or three hundred years ago the Chinese had for many centuries enjoyed the distinction of standing first among the people of the world in all that pertains to the useful arts and to the sciences. Had they been shrewd enough to conceive and develop the induction system of philosophical inquiry which Lord Bacon recommended in his "Vorum Organon," and which has produced such splendid results in the history of European science, they might have continued to occupy the same proud position. The Chinese are not deficient in mental vigor or incapable of scientific research. Give to them the same conditions of national activity, and give them also a correct principle of philosophy, and you will find them making equal progress in science with the people of any European nation. "The constitutional ingenuity and industry of the Chinese has led them to fall upon various practical results in spite, as it would seem, of a feature of their character and habits which is opposed to the progress of knowledge. They profess to set no value on abstract science apart from some obvious and immediate end of utility." We discover and long subsequently make the application to the practical purposes of utility. Our efforts are not only directed toward the deduction of useful purposes from what is known, but also toward the discovery of what may not be immediately useful. In other words, we cultivate science not only for the benefit which may be derived therefrom, but also for its own sake. The latter motive has no existence among the Chinese. They have made many accidental discoveries of useful inventions, and consequently, relying upon this method, have stumbled slowly in the dark along the road of progress; while Europeans, guided by the light of that system of logic which Bacon gave to the world, have made rapid advances, and far outstripped them in the race. The Chinese have classified and generalized, but they have done this without first having prepared the way by proper research. They systematize without experiment, and it is this which has kept that country in the dark in regard to every department of physical knowledge while the inductive method of scientific inquiry has been attended with such glorious results. Take botany, for instance. The Chinese works treating on this subject are quite minute and almost exhaustive, so far as the flora of their own country is concerned. In their treatment of this subject they have a definite plan, classifying plants and arranging them in different orders and families. But their classification is unscientific, because they have failed to obtain sufficient accurate information on which to build by inductive reasoning a natural logical system of classification. The Pun Tsan or Herbal is their great work on materia medica. It is embodied in about forty octavo volumes, and, as it exists, is almost an encyclopedia of Chinese medical knowledge. The whole work is divided into 52 chapters. The first four of these treat upon the practice of medicine, therapeutics, pharmacy, and diagnosis by the pulse. The rest of the work is taken up in a description of the different substances in the three kingdoms of nature, their medical properties and pharmaceutical preparations. One-half of the work is devoted to the vegetable kingdom, which is there classified under five different divisions, as follows: herbs, grains, vegetables, fruits, and trees. These are again subdivided according to some apparent but not real relation which individual plants sustain to each other. Thus the cocoanut palm appears in the same group with the lichi, a species of plum; while the grape is side by side with the sugar-cane. Thus, without sufficiently studying the organization of plants, they have attempted a classification which can serve no scientific purpose such as has already been gained from the natural system introduced by Bernard and Jussieu, even though still in an imperfect state.

The comparatively low state of medical art in that country is partly explained by the small consideration in which the profession is there held. There are no public schools of medicine except one recently established at Pekin, and no means of becoming acquainted with even the limited knowledge which they possess, except so far as it may be done by studying with individuals engaged in practice. The medical fraternity do not enjoy the social advantages which are afforded to the profession here, and to a still greater extent in European countries. A knowledge of the classical writings of Confucius and Mencius does more to advance the pecuniary, social, and political interests of the student, owing to the standard of their competitive examinations for governmental promotions, than the most perfect acquaintance with the sciences could do. Quackery is practiced there as it is in all the Eastern countries, and those who bolster up their pretensions to medical skill by tricks of jugglery or vain assumptions of wisdom which they do not possess enjoy equal honors with those of more thorough accomplishments. In this respect the Chinese people are not much less discerning than the public of our own land. These quacks are too often made to appear in the eyes of foreigners residing in that country as the true representatives of the Chinese medical profession. An amusing instance of the successful imposition of a Chinese pretender upon the credulity of a distinguished European family was related to me by a friend, who, I believe, was a witness of the exposition of the fraud. The wife of an English Consul, residing at Shanghai, was suffering from toothache. Listening to the suggestion of a friend, and predisposed to believe in the superior skill and attainments of the Chinese, she permitted a Chinawoman of celebrity among her own people to be called in, hoping to obtain relief from her treatment. This female dentist proceeded to examine her mouth and to probe her tooth with a long pin of the peculiar shape ordinarily worn in the hair by Chinese women, which she conveniently took from her own head. After searching awhile she brought out a live maggot, wriggling on the end of her hair-pin. This was too much for the sensibilities of the English lady, and yet here was, to her, the indubitable fact. Did she not see the maggot with her own eyes? Of course the request was made to remove all these disgusting vermin, which she was now convinced had been the cause of her suffering. After removing several of them the Chinawoman desisted, but suggested that she had better come another day and see if any more could be found; possibly some might hatch out in the meantime. The operation was repeated on several successive days, much to the astonishment and even admiration of the enthusiastic Consul and, wonderful! the medical officer of the Consulate, who now clearly perceived the great skill and profound wisdom of the Chinese people. Without delay the physician of the Consulate wrote a long and elaborate communication to an English philosophical society, of which he was a member, describing the wonderful superiority of Chinese science in general, and of its medical science in particular, giving as an illustration this startling revelation which had been made to him, that toothache was caused by maggots. After sending the paper away it chanced that a number of gentlemen met at the residence of the Consul, among them several who had been for many years in China, and were more familiar than he with the trickery of this class of people. The enthusiastic Consul could not refrain from mentioning his discovery, and, as doubts were expressed, he indignantly sent for the Chinese woman to come, if, perchance, she might find some more of the obnoxious vermin, and thus convince the skeptical barbarians. The woman came, and was successful in drawing out the worm, but not successful in imposing upon all of the spectators.* Seeing her introduce the probe into her own mouth before making the second exploration, a missionary standing by reproved her, in her native tongue, for this want of cleanliness, and, taking the probe from her, wiped it clean. At this the Chinawoman became angry; said she could do nothing if the foreigner interfered with her; and then, after placing the probe in her own mouth again, attempted to pass it into the mouth of the English lady. Some one caught her hand, and, turning over the probe, revealed the maggot which she was attempting to carry into the tooth before bringing it out for exhibition. She had brought a supply of maggots in her own mouth, and, by dexterously managing them, had imposed upon the Consul and his lady. The chagrin of the physician who had sent the paper can better be imagined than described.

It would be unfair to take this as an illustration of the practice of medicine in that country. Although the members of the regular profession in China make larger pretensions than we think are justifiable, they do not as a rule resort to such tricks to create or support for them a reputation.

In regard to the state of the medical sciences in that country not much can be said that is creditable to them. Their attainments are just what we might expect from a people who have relied upon accident rather than patient investigation for their discoveries. They have stumbled upon a great many things that are useful in practice and have invented theories which are absurd and childish. Chemistry as a science is unknown, though many of its operations are familiar to them. To a certain extent they have been inspired by the vain hope of discovering some process by which the baser metals may be transmuted into those which they regard as more precious, such as gold and silver. Alchemy, however, has not there the same number of enthusiastic votaries that it had in Europe, the Chinese being too practical a people to indulge in chimeras or to pursue for a long time such a flitting light as that *ignis-fatuus* which led its European followers at length into the fruitful territory of true chemical science. Sir John Davis, in his excellent work on China, relates in detail an account of their manufacture of mercurial preparations, and he bears favorable testimony to the shrewdness and ingenuity of the Chinese in the existing state of their knowledge. Of the physical structure of the human body and the functions of its various organs they know but little. They do not dissect, nor does it appear from their descriptions of the body that the science of anatomy has ever been cultivated among them. Their speculations in regard to the internal structure of the human body are extremely absurd. I quote a few of them by way of illustration: "The small intestines are supposed to be connected with the heart, and the urine passes through them into the bladder, separating from the food or fæces at the caput coli, where they divide from the larger intestines. The large intestines are connected with the lungs and lie in the loins, having sixteen convolutions. The kidneys are attached to the spinal marrow, and resemble an egg in shape, and the subtle generative fluid is eliminated by them, above to the brain and below to the spermatic cord and sacral extremity; the testes, called wai shin, or outside kidneys, communicate with them," etc.

Of course with such notions in regard to anatomy their speculations in regard to physiology and pathology are entirely useless and appear to us as idle nonsense. The principal causes of disease enumerated by them are the adverse influences of evil spirits, the existence of impure humors in the body, and especially the disarrangement and inharmonious relations of those all-pervading principles of nature, those universal causes in their philosophy, the yin and yang, sometimes called the male and female elements diffused throughout nature.

Their theories in regard to disease, their symptomatology and means of diagnosis are quite in harmony with their want of knowledge of the human body. S. Wells Williams, that most eminent of Americans in China, states in his valuable work that "the common classification of diseases is under nine heads, viz., those which affect the pulse feebly or violently; those arising from cold; female and cutaneous diseases; those needing acupuncture, and diseases of the eyes, the mouth and its parts, and the bones." The means of diagnosis on which they most rely is the condition of the pulse. By this they profess not only to know the organ affected, and the nature of its disease, but to ascertain things which we have as yet discovered no means of knowing, viz., the sex of an infant while it is yet hidden in the womb.

In certain departments the Chinese practice of the healing art is far in advance of their science. Here they have had experience to guide them, and the result has been the discovery of much that is useful in the management of some

diseases. Without pursuing this subject at length, I will mention some of the means employed by them for the prevention and treatment of disease. Inoculation for small-pox has been practiced there for many centuries, and to them we owe its introduction into Europe through the Arabs. Again they have established lazar houses throughout the Empire for the isolation of those affected with infectious or contagious diseases, and lepers are separated from the rest of the people and required to live in villages by themselves, where they are permitted to intermarry only among themselves. The Chinese recognize the importance of dietetics in the treatment of disease, and probably derive from it as much assistance in their practice as in the administration of medicine.

Acupuncture, the moxa, leeches, cupping and the application of counter irritants or caustics are commonly employed by them in their practice. Blood letting is also practiced, though disapproved in fevers, for, as they say, "a fever is like a pot boiling; it is requisite to reduce the fire and not diminish the fluid in the vessel if we wish to cure the patient." Among the medicines employed by them is mercury in some of its different preparations. Their list of medicinal agents is very extensive. I have already referred to their great work on materia medica, the Herbal, which comprises about forty large octavo volumes. Among their medicines described there, and commonly used, are many that we use in our own practice, as camphor, rhubarb, gentian, myrrh and ginseng, and many also which from their very strangeness are prized very highly, judging from the prices paid for them, as the scales of the pangolin, horns of rhinoceroses, paws of bears, tigers' bones, dried hippocampi, petrifactions of crabs, bezoar of cows, etc. Almost everything is by them regarded of use in medicine and is embodied in their work on materia medica.

The practice of obstetrics among them is principally left in the hands of the women, and it is probably managed by them as efficiently as any department of the profession. Dr. Lockhart, of Shanghai, has translated a native treatise on midwifery, containing much good advice in the management of women in childbirth. They do not appear to have any such cruel custom among them as that which I have described as prevailing among the Siamese. They know nothing, however, of the use of instruments in difficult cases of labor, and parturition is practically accomplished by the unaided powers of nature. As might be expected from their limited acquaintance with the science of anatomy, surgery is to them almost an unknown art. They never attempt to perform any of the more difficult surgical operations, and their practice is confined principally to such minor operations as the removal of teeth, reducing dislocations and setting fractured limbs, or the amputation of the smaller members, puncturing abscesses, etc. They are rather more proficient in this branch of the profession, however, than a homeopathic physician, so called, of this city, who recently wanted me to open a large deep seated abscess on one of his patients, and who in making the attempt himself succeeded in making a scratch deep enough to let out only a half dozen drops of blood, leaving his patient to suffer two or three days before the half pint of matter it contained made its way to the surface. In dentistry the Chinese have for many years known how to adapt false teeth to the mouth so as to make them serve in the place of natural ones tolerably well, though their work is quite inferior to that of our American dentists.

I have already referred to the low esteem in which our profession is held in that country as one of the reasons why greater advances have not been made in medical science. Before leaving this subject I will mention one or two obstacles in the way of effecting a change or improvement in the practice of the art there. One is the great reverence which they feel for everything that is ancient. Whatever was not known to their forefathers they consider unworthy of recognition. The greatest recommendation which can be given to any discovery of modern times is that it was known and referred to by the ancients and is now only reproduced, not newly discovered. And thus it occurs that the practice which old custom has sanctioned is considered the best, and their materia medica remains unchanged from generation to generation, its established authority in the country being the Herbal, a treatise which was compiled from older works between two and three hundred years ago. Another reason is found in the laws of the country relative to malpractice. I quote that section of the Code which refers to this matter: "Whenever an unskillful practitioner in administering medicine or using the puncturing needle proceeds contrary to the established forms, and thereby causes the death of the patient, the magistrate shall call in other practitioners to examine the medicine or the wound, and if it appear that the injury done was unintentional, the practitioner shall then be treated according to the statute for accidental homicides, and shall not be any longer allowed to practice medicine. But if designedly he depart from the established forms, and deceives in his attempt to cure the malady in order to obtain property, then according to its amount he shall be treated as a thief; and if death ensue from the malpractice, then, for having thus used medicine with intent to kill, he shall be beheaded." Such a law cannot but repress any departure from the ancient and established modes of treatment of disease.

I shall say but little in regard to the condition of medical science and practice in Japan. In the state of transition in which it is at present it is impossible to describe it accurately. It would be incorrect to say that the Japanese have any distinct system or school of medicine which they may call their own. The people are imitative in their character, and though quick to perceive and copy from others, I believe they are incapable of giving origin to any new ideas or of building up a science. We look with admiration upon the wonderful changes which are transpiring in their country, on their rapid adoption of the European arts and sciences. But do we not see in this very thing the changeableness and instability of their character? If left to themselves, if denied any intercommunication with the representatives of foreign genius and skill, I have no doubt that all which they have learned would soon become of no avail to them, and that they would rapidly sink back again into a condition far below that of their neighbors on the continent of Asia. The knowledge which they possess is not their own, but borrowed. Until recently the absurd theories of the Chinese were adopted, and the practice of their healing art copied without improvement or change. Now they are borrowing from Europe and America, and all their science and art, including that of medicine, is of hybrid nature, a strange and complicated mixture of the old and new, the ancient Chinese and the modern European. In regard to medicine, the principal features which I wish to notice are, first, the establishment of hospitals throughout the land under the care and management of competent European and American physicians, and, second, the number of Japanese who are availing themselves of the opportunity to study our system of practice both in these hospitals and in the various medical colleges which have been established at the capital and elsewhere, in which the science of medicine is taught by a corps of European professors. Our medical text books are rapidly being translated into their language, our medicines imported in large quantities, and our system of practice adopted by them to the gradual crowding out of the long naturalized Chinese mode; and all this is done without that cautious verification of our science and art which a more conservative and substantial people would give. They are not capable of making those experiments upon which our inductive science is based or by which it may be tested.

In closing this paper I will briefly restate the distinguishing characteristics of the condition of medicine among those people to whom I have here referred. Among the rude, wild, uncivilized Kamoocks medical art is unknown, and their only efforts in behalf of the sick are directed toward the appeasement of the spirits whom they suppose have caused the disease. Among the Laos there is a distinct class whose function it is to practice the healing art. All their knowledge, however, is traditional, and their practice is combined with religious offerings. The Siamese have a medical literature which is not extensive, and a practice based upon a minute but unscientific symptomatology similar to that of the early school of Hahnemann. The Chinese have a profuse medical literature almost equal in extent to our own. Their art is ancient and unchanging, and their knowledge characterized by absurd speculations. They have not yet learned to appreciate the value of those inductive experiments upon which all the physical sciences must be based. Here we find evidences of an attempt to classify their knowledge and to establish a system which harmonizes through out. Empirically they have stumbled upon many things of value which they use in their practice. They have also some appreciation of the importance of hygienic measures, as evidenced in their lazar houses, in the isolation of lepers, and in the dietetic management of the sick.

The Japanese science and art of medicine is in a transitory state. Medical colleges and hospitals have been established in different parts of their country, and many European physicians are employed in teaching our science and training native students in the practice of medicine and surgery as it exists in our own land. Of all these people it may be said that they are wanting in that system of inductive inquiry by which our science and practice of medicine has been brought to its present degree of excellence.

It was my intention when I consented to prepare a paper for this society to make a brief review of the state of medicine in the different countries which it was my privilege to visit when abroad, and then to notice some of the principal diseases prevailing in those lands, especially some that are fortunately not often seen in our own country, such as elephantiasis, leprosy, beriberi, and some of the skin diseases. I found, however, that this would require either too lengthy a paper to read here or that I could not give to the different subjects the attention which their importance demands. I have therefore confined myself in this paper to a consideration of the condition of medical knowledge and practice in these countries, Siam, China and Japan.

EXTIRPATION OF THE LARYNX.

By David Foulis, M. D.,

Lecturer on Pathology, and Extra Dispensary Surgeon in the Glasgow Royal Infirmary; Surgeon to the Throat Dispensary, Dundas Street.

Four months have now elapsed since I removed the larynx, and the patient has returned to his home in a satisfactory state. I wish to detail the further steps which were necessary in order to bring about this result.

As soon as the wound appeared to be sufficiently contracted, I tried to introduce the voice-tube sent to me by H. Reiner, of Vienna. This apparatus (Fig. 1) consists of two tubes, one of which (B) passes into the open trachea, while the other (A), fitting into the tube B, passes upward to the epiglottis. Into the upper tube (A) slides a silver case containing a plate with a vibrating reed. The anterior opening of the apparatus is closed by the button (C), and the current of air is directed past the reed, and through the apertures in

Fig. 1.

Sectional view of Gassenbauer's voice-tube (full size).
A, Upper tube, which passes up toward the mouth.
B, Lower tube, which enters the trachea.
C, Button with reed-plate attached.

the tubes. As the upward current impinges on the reed, the latter is thrown into vibrations, and a continuous musical note is produced, which is then modulated into vowels and consonants by the mouth.

At this stage several difficulties appeared. In the first place, the tube, owing to its shape and its small size, did not fit the wound, and the reed being besides rather stiff and difficult to sound, the apparatus was laid aside. I found also that the upper part of the wound had contracted very much, so that I could scarcely push the tip of my little finger into it. The enlargement of the upper part of the passage was therefore the first point to be attended to, and this I effected by inserting my finger into it for a short time daily, until in a week or so I was able to pass my middle finger from the wound in the neck up into the fauces, and to leave it in the channel for a minute or two. This upper end of the wound was very sensitive, possibly owing to the presence of the end twigs of the superior laryngeal nerve, and the introduction of the finger was followed by violent fits of spasmodic coughing, accompanied by a sort of suffocative spasm. This happened in spite of the fact that, the upper end of the trachea being wide open, the air had free access to the lungs, and it was probably to be explained as a reflex spasm set up by irritation of the nerves in the upper end of the wound.

While this dilatation was in progress, various attempts were made to procure a tube which would fit the peculiar shape of the wound. In this task I was indebted to Dr. Irvine and Mr. Foulds (dentist) for invaluable assistance. Dr. Irvine having suggested and embodied in a rough model the idea of reversing the relative position of the tubes, Mr. Foulds produced a tube (Fig. 2) which is at once light, smooth, easy to wear, and close-fitting to the wound. From the accompanying sketch it will be seen that this voice-tube is based on the plan of that of Gussenbauer, with essential modifications. For example, the lower tube slips into the upper one, thus permitting the upper tube, which is the more difficult to insert, to be put first into its position in the wound. And, again, at Mr. Foulds' suggestion, the reed-plate is not inclosed in a silver case, but is simply pushed into a groove in the sides of the lower tube, like a drawer. When pushed home, the reed-plate slopes downward, and the current of air from the lungs impinges upon the free end of the vibrating reed, instead of being reflected along it from the root, as in Gussenbauer's tube. This is found to give a better note than that produced by Gussenbauer's arrangement. I need not detail all the difficulties met with in fitting this tube to the wound. One of these was the determination of the length of the upper tube. The epiglottis having been left attached to the root of the tongue, it was necessary to leave the tube of just such a length as would allow the epiglottis to close over it in swallowing, and would at the same time keep the mouth end of the wound patent. The tendency of the uppermost limit of the wound to close over was for a time very troublesome, and interfered with the clearness of the voice in a capricious manner; while if, on the other hand, too long a tube were used, there was excessive irritation and salivation, the most of the saliva finding its way into the trachea, where it excited hard, painful coughing. The sketch (Fig. 3; see next page) shows the position of the tube in the throat, and the length now fixed on as the best for the upper end. For precaution's sake a cork is inserted into the upper end of the tube at meal-times, any accidental spasms of coughing being undesirable in the suspicious state of the apex of the right lung, alluded to in my former paper. But the amount of salivation having greatly diminished, the use of the cork is now less necessary.

Fig. 2.

Sectional view of voice-tube used by the patient (full size).
A, Upper tube. B, Lower tube slipping into the upper tube and holding the reed-plate and button (C).

The question of the formation of the reed was also of much interest. The reed in the Vienna instrument was made of thin German silver plate, and those which Mr. Foulds at first made were of brass. Dr. Irvine found, in the course of experiment, that soft vulcanite answered well for the purpose; and on the model of the one so made the patient himself has been able to manufacture reeds of various materials—ivory, horn, vulcanite, cane, etc.—with which he amuses himself. I had some reeds of German silver and steel made by a jeweler. Latterly, Mr. Foulds has made one of an alloy of silver and brass, which gives the richest tone of all, and which is the favorite one with the patient owing to the ease with which it is vibrated. The patient has thus a large number of voices at command; and it is very instructive to watch the variations in the timbre or quality of the voice in changing from one reed to the other. The softest and perhaps the most natural notes are given by the non-metallic reeds, those made of metal giving a more ringing tone. With the same buccal cavity, we have a tenor or baritone quality imparted to the voice by the use of one or other of the reeds, which fact goes to confirm the opinion already expressed by authorities that the timbre of the human voice depends as much upon the density, elasticity, and other qualities of the vocal cords as on the accentuation of particular sound waves in the buccal cavity.

The articulation of the patient with this apparatus is wonderful. Except for the monotony, it cannot be distinguished from the natural voice. The vowels are perfectly clear and distinct, both in whispering with the reed out and in intoning with the reed in the tube; proving, if proof were wanted, that the vowels are the product of changes in the shape of the buccal cavity, and are not formed by alterations of the glottis. I had the pleasure of showing the patient to Professors Sir William Thomson, M'Kendrick, Clelland, Graham Bell, and others at the University on November 13th), to the Pathological and Clinical Society (November 13th), and to the Philosophical Society of Glasgow (November 21st), and on these occasions he was able to convince the gentlemen present of the reality of his vocal powers. More recently, having become more expert at the manufacture of reeds, my patient has made for himself a vulcanite reed with which he can positively roar. This reed requires, of course, a stronger current of air to make it vibrate than the others require, they in turn vibrating only in an air-current of a

certain strength. All the reeds remain silent in ordinary breathing.

It is notable that the sound of the voice is interfered with by anything which even partially closes the upper end of the tube. If the tube, for example, be too short, and the soft parts fold themselves over the upper end, the voice is liable to be suddenly interrupted; while if the epiglottis lie far back over the end of the tube the pitch of the note is lowered and the tone itself damped and rendered less ringing. This seems akin to the effect of large tonsils, or other swelling above the glottis, in altering the air-current, and with it the voice—the glottis itself remaining quite healthy. The voice in such cases is more or less muffled and depressed in pitch. This muffling of the note follows whenever the exit of the sound is in any degree hindered. For when, the finger being placed on the aperture at c (Fig. 2), so as to close only that part of the opening which is below the reed-plate, the sound is allowed to emerge through the half aperture above the reed-plate, we hear a higher and clearer note than we bear when, the whole of the aperture at c being closed, the sound is emitted at the upper end of the tube. This is still more marked when the same observation is made with the tube in the neck of the patient, indicating a further muffling by means of the mouth cavity. My friend Mr. Moodie was good enough to test this for me with the tuning-

FIG. 3.

Sectional view of head and neck, showing the relations of the voice-tube to the soft parts, and the manner in which it replaces the larynx. (Modified after Brauno's plates.)

fork, and he determined a difference of a half or even a whole tone, metallic reeds giving the least variation. It was sufficiently marked to allow of dissent from the opinion expressed by M. Gavarret that the oral cavity is too short to influence the pitch of the note produced by the vocal cords. It appeared to indicate rather that the note is materially altered in pitch in its transmission through the mouth. This is a point which might be elucidated by observation of the sound in cases of cut-throat. At Dr. Irvine's suggestion a further test was applied. The patient was directed to sound a vowel over a considerable period of time, during which the sound was at first allowed to come out at the front aperture of the tube, then through the mouth, and finally transmitted through a tubular roll of paper held closely to the mouth. As these steps were taken the sound became gradually lowered in pitch, the reed of course remaining the same. There could here be no involuntary modification of the glottis to suit the tube, and the experiment showed vividly the function which the buccal cavity exercises with respect to the pitch of the voice.

In concluding this notice I must allude to the general health of the patient and to the prospect of the recurrence of the growth. There is as yet no sign of the latter, and the two glands, which before the operation was performed were large and dangerous-looking, are now very small. They can still be felt on careful examination, and should they give any trouble they can be excised. The patient remains as before, rather subject to colds, and during his stay in the Nursing Home there was a sharp attack of bronchitis in the right lung, with crepitant râles at the apex and half way down the lung, with an evening temperature of 99° to 101°. With this there were slight sweatings at night; but after causing us much anxiety for a fortnight, this passed away. The temperature is now nearly normal, betraying an occasional tendency to an evening rise of half a degree or so. There is just a trace of sweating at night at rare intervals. To physical examination the right lung is as sound as it has been since I first saw the patient, an opinion confirmed by Dr. Finlayson, who has kindly examined the chest from time to time.—*Lancet.*

DISTENDED BLADDER.

UNIVERSITY COLLEGE HOSPITAL, LONDON.

[Under the care of Mr. BERKELEY HILL.]

J. B——, aged forty-three, was admitted July 11th, 1876. Had gonorrhœa at fourteen and at sixteen years of age; each attack lasted twelve months. For the last six years he had had frequent calls to make water, with straining and small streams. An instrument had never been passed to the bladder, though three years ago ineffectual attempts were made by a medical man. From Dec., 1875, to April, 1876, he had attended as out-patient at one of the London hospitals, for the "stricture," and for difficulty in passing his motions.

On admission, the patient complained of pain and straining in micturition, and of difficulty in defecation. The fæces were small and flat. The urethra, measured by the urethrometer, was equal to No. 22 (French scale) through the meatus; beyond that point, No. 35 (French) passed easily up and down the penile part. In the rectum, the finger found no induration or contraction of the gut, and the lower part was free from fæces, but the base of the bladder was distended. There was a dull note on percussing the suprapubic and left inguinal regions. The meatus was incised till No. 35 French bullet sound could pass in and out freely. A flexible coudé catheter was passed, and more than a pint of urine drawn off. When the bladder was empty, a soft, irregular mass behind it became distinct. The patient was ordered to remain in bed, and take a sharp purge, which acted copiously. Henceforth he was much relieved, and by July 18th had lost his old symptoms altogether. He passed urine without straining, and could hold it all night; his bowels acted easily; the tumor of the rectum was no longer there. Patient discharged.

On Oct. 3d the patient called at the hospital. He was quite free from the troublesome straining, and otherwise well.

When drawing attention to the foregoing case, Mr. Hill narrated the following example of the extent to which the urinary bladder can be expanded by long training. In this instance, twelve pints of urine had accumulated, and were mistaken for malignant disease of the liver and ascites.

On March 4th, 1876, he (Mr. Hill) was called to Mr. ——, aged forty-six, in whom it was said his homeopathic medical attendants had diagnosed fatal liver disease, and had recommended him to settle his affairs, as he had not long to live. Alarmed by this intelligence, the patient consulted Dr. Murchison on March 3d, who had declined to give an opinion until the bladder had been emptied. This operation was at first declined, but, as the patient's sufferings increased rapidly, application was again made to Dr. Murchison, and he referred the friends to Mr. Hill. On reaching the patient's house Mr. Hill found him much distressed by great distention of the abdomen. Having been for years of sedentary habits, he had accustomed himself to hold his urine for long periods. There had never been a stoppage or even difficulty in passing urine. He habitually rose once every night. The bowels were fairly regular. Since May, 1875, swelling of the abdomen had gradually come on, with loss of appetite and restlessness. No special pain. For three weeks before he had been obliged to micturate every hour, and passed a teacupful at a time of clear urine. A prominent dull-sounding tumor occupied the middle of the abdomen as high as the pit of the stomach, resembling a gravid uterus. In the flanks there was a clear note on percussion. No anasarca of the lower extremities; no jaundice. A flexible catheter slipped along the urethra to the bladder without the slightest hitch, and pale urine was let off to the amount of seven and a half pints (150 oz.). The catheter was then withdrawn, while urine still flowed. As the urine ran off, a jack towel was drawn tightly round the body, and afterward pinned. The patient was warned not to sit up or leave his bed. The abdominal tumor, much smaller, was still plainly felt below the umbilicus. Next morning, twelve hours after the first evacuation, the patient had passed a very comfortable night, and had taken two eggs in a teacupful of milk, but no other food or drink. A silver catheter then passed without hitch to the prostate, where a slight obstruction was felt that was easily overcome, and five pints (100 oz.) of clear urine were drawn off. This done the tumor had quite disappeared. The finger in the rectum found no hemorrhoids; the prostate, perhaps slightly larger than usual, was not tender or hard. The liver dullness did not descend below the margin of the ribs, and the flaccid abdominal walls enabled the abdomen to be explored easily. There was no tumor. The urine was pale, clear, free from albumen or pus, neutral or slightly acid, specific gravity about 1012. The patient remained for some days without power or desire to micturate, but quickly learned to pass a No. 18 French flexible catheter, and to draw off his urine twice daily. On the third day he resumed business, feeling quite well, but rather weak. In a fortnight voluntary micturition began to return, and was gradually completely restored. In October, 1877, a year and a half afterward, the patient was enjoying good health.

In his remarks on these cases, Mr. Hill observed that both showed that a trifling cause (not the same in both cases) might produce very distressing and even dangerous symptoms, of which the origin, from its apparently trifling nature, might be overlooked. Organic stricture near the meatus urinarius, when depriving the outlet of only a small part of its natural width, could excite reflex irritation, which showed itself in divers ways—neuralgia of the loins, hips, testes, and lower extremities; paraplegic symptoms, sexual incompetence, and other forms of nervous disturbance. Perhaps one of the most common was difficult micturition, manifesting itself in the mode often thought diagnostic of organic stricture of the bulbous part—namely, frequent call; slow, small, forked stream; pain in passing and dribbling after the flow of urine. In such cases attention may be entirely directed to the deeply situated contraction of the urethra, while no means are taken to ascertain the presence of, or to widen, the anterior stricture, because, not being drawn closely together by spasm of the surrounding muscles, it offers no impediment to the small instrument necessary to pass through the deeply placed contraction. Such deeply placed contraction may be due to muscular spasm acting on a scantily developed organic stricture at the bulbo-membranous part. This spasm will speedily subside if the anterior coarctation be removed, and the deeply placed stricture will then be found to be of only moderate narrowness, insufficient to excite the difficult micturition previously present. In the case above narrated the bladder was habitually more or less distended, the stream was slow and small, and the symptoms simulated either perineal stricture or prostatic deformity of the neck of the bladder. Further, the rectum, from disturbed nervous stimulus had become irregular and inefficient in action, and thus suggested the existence of stricture of the gut.

In the second case, most probably the cause of distention was the habit of delaying to void urine, and thus gradually the overtired and enlarged bladder lost the power of complete contraction, until rest by regular artificial evacuation had restored its muscular contractility. It is true that some slight coarctation of the urethra might have existed, for which, in the emergency, search was not made; but, as the patient could himself at once easily pass No. 18 French (No. 10 English) catheter, the stricture, if it existed, must have been very slight; nevertheless, such a cause could possibly have assisted in producing the distention, though more probably irritability of the bladder in that case would have been an early instead of a late symptom. The point of greatest interest in this case was the recovery of the patient after this prolonged enormous distention. Not infrequently, perhaps most commonly, in these cases of excessive accumulation of urine, in from twenty-four to seventy-two hours after the bladder is emptied, inflammation of the bladder and pelves of the kidneys sets in, accompanied by diffused suppurative nephritis; and in ten or fourteen days the patient dies. That this result did not follow here was perhaps due to the fact that the over-distention had not been preceded by years of renal irritation from narrow stricture, and thus slow interstitial nephritis had not lowered the vitality of the organs below the point whence they could recover from disturbance of the circulation and conditions of function.—*Lancet.*

SANDALWOOD.

THIS wood grows extensively in the forests of Mysore, but its cultivation has been restricted from the remotest period; at present about four lakes of rupees accrue to the state revenue from the sale of Mysore sandalwood alone. The shade cast by the sandal-tree is said to be injurious to the growth of vegetation. In Mulnad the trees grow hardy, straight, and stout, the planks being used for the manufacture of boxes, etc. The trees growing on the plains are stunted in growth, but they surpass the Mulnad wood in perfume. The wood is put to several uses besides the making of curiously-carved boxes, fans, and other fancy articles. The dust left after sawing is used for incense. The oil makes the attar which is used as a sweet scent. The seaborne exports of Mysore wood for ten years have been on an average 380 tons a year. The distillation of oil from the roots is carried on chiefly at Mangalore. Five cwt. yield 40 seers of pure oil, thus giving a profit of nearly 37 per cent. The market for sandalwood is an ever open one, and, much as we may desire to use the wood for cabinet purposes, we are not likely to see much of it at present. As opium ministers to the sensual gratification of the Chinese and others of the same class, so sandalwood ministers to their superstition. Without it no religious ceremony can be conducted, and its absence is a mark of poverty, so that the Oriental of India and China will sacrifice anything rather than suffer that, on the proper occasion, sandalwood should not be burned.

LAYING DOWN RASPBERRIES.—There is no doubt that all raspberries which are slightly injured by our severest winters, as well as the more tender ones, are benefited by winter protection. They start with more freshness and vigor when uncovered in early spring, and they bear better. The *Rural Home* says that the largest yield which the editor ever saw of the Franconia (which is often injured by winter in our latitude) followed the laying down the canes their entire length and covering with stable manure, and no other sort which he ever knew gave such a crop.

NEW GENUS OF LUMBRICULIDÆ.

AT the last meeting of the San Francisco Microscopical Society, Dr. Gustav Eisen called attention to a new worm, about 20 inches long, which he had discovered in an irrigation ditch in Fresno county. His remarks were illustrated by exquisite drawings. The worm was a member of a new genus of *Lumbriculidæ*, which family had hitherto not been known to exist outside of Europe. Of this family only five genera were previously known, viz.: *Styladrilus, Lumbriculus, Rhynchelmis, Phreatothrix, Trichodrilus.* The new genus added to the list was *Acnerodrilus.*

Lumbriculidæ differs from all other families of *Oligochæta* in having four efferent ducts in the segment. *Stebificidæ* and other families had only two ducts in the same segment. From the genera in the same family *Acnerodrilus* is most remarkably distinct, nearly all its organs showing characteristics which even would place the genus in a new family. As very little is known of the anatomy of the *Oligochæta* or earthworms, every contribution is valuable and interesting.

In all other genera of *Lumbriculidæ* the ventral vessel is divided in some of the anterior segments; in *Acnerodrilus* the same vessel is entire. In all other genera of *Limicolidæ* the dorsal vessel is entire. In *Acnerodrilus*, on the contrary, said vessel is divided in three branches, all three connecting in every segment with each other and with the ventral vessel. The alimentary canal is in the *œsophagus*, furnished with two large sack-like appendices, not met with elsewhere in this order. In the eight and ninth segments we find two pair of large pulsating hearts. In the other genera no hearts are met with.

Two pair of minute testes are found attached to the dissipirnents in the eighth and tenth segments. In other genera the testes are seldom found in pairs and always very large, often filling a large part of the body. The ovaries are situated in the eleventh setigerous segment, and the oviducts, which, contrary to what is generally the case, are very large, in the thirteenth setigerous segment. The efferent ducts are from the upper quarter, grown together, and at their lower end not furnished with any prostate glands; neither do they enter a common atrium, which is elsewhere always the case. But the most remarkable characteristic of *Acnerodrilus* is that the efferent ducts and the receptacle open into the same external porus in the sixteenth segment, a fact not elsewhere met with. The receptacle, which is extraordinarily long, extends from the sixteenth to the twenty-fifth segment and sometimes further back.

Besides *Acnerodrilus*, the Doctor has also found a species of each of the genera *Lumbriculus* and *Rhynchelmis*, the former in marshes in Sierra Nevada, the latter in the old mountain lake, near the Marine Hospital, San Francisco. Besides, the Doctor thought that many new and interesting worms could be discovered in the many lakes and ponds of California, and called the attention of the members of the society to the value and interest of even the smallest contributions, which he would most thankfully receive.—*Mining and Scientific Press.*

GUN COTTON SPECTRUM.—The spectrum of the light of exploding compressed gun-cotton has lately been observed by M. Schöttner ("Carl's Repertorium"). Its lines showed a perfect coincidence with those of the calcium spectrum; there were also the lines of potassium and sodium. The occurrence of these lines is explained by the fact that in manufacture a solution of raw soda is added to the gun-cotton, and, after drying, about 1 per cent. of this remains in the material. The soda is designed to prevent spontaneous decomposition of the gun-cotton. The potassium lines could be removed by lixiviation with hot water, but not those of sodium and calcium. M. Schöttner also examined the spectrum of burning nitro-glycerine, which, after small additions of kieselguhr, could be ignited by means of an incandescent platinum wire. A very weakly luminous continuous spectrum was obtained, with bright expanded sodium lines alone.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 62. BY J. BERGER, GRAZ.

[Belonging to the set of two problems to which the first prize was awarded in the Cologne Chess Congress.]

Black.

White.

White to play and mate in three moves.

P. T. DUFFY, OF LONDON.

Either side to mate or self-mate in 2 moves.
By J. B. MUNOZ.

BY the introduction of Mr. Duffy to our readers we complete the sequence of distinguished players who have edited the chess department of the London *Illustrated News*, Mr. Duffy having been selected as a worthy successor to the late Mr. Wormald. He is not only one of the strongest English players and most clever writers and critics, as shown by his able management of the famous Westminster papers, but he is also a skillful problemist in whose compositions we find the very highest order of merit, neat and graceful positions, free from that "cumbersome complexity" with which our modern composers are apt to smother their ideas. We are not aware of Mr. Duffy ever having taken part in problem tournaments further than to act as umpire, so we cannot say in which tournaments he has competed or been successful. We could give a score of his compositions, many of which are familiar to most of our problemists. We will only quote the following, however, which has long been a favorite with us, and which can be taken as a fair specimen of his style and skill.

We had a pleasant time with him during his recent visit to the States, and found him well up on the problematical questions of the day. We regret that his sudden departure prevented our receiving a more recent picture, from which a better likeness might be secured.

ENIGMA No. 34.—By P. T. DUFFY.

White.—K on Q 7, Q Q B 2, B K Kt 5, Kts K sq and Q R 3, P Q B 5.
Black.—K Q 4, R Q 5, Ps Q R 3 and K 4.
White to play and mate in three moves.

THE LINCOLNSHIRE CHESS ASSOCIATION.

THE meeting of this English Chess Association was held at Grantham, and was a most successful and interesting meeting. Additional *éclat* was given to the tournament by the patronage and liberality of Prince Leopold, who added a beautiful silver cup of the value of $25 to the first prize, making the first prize amount to about $75, the second prize $25, third prize $10. Each player was required to deposit 10s. 6d., as a guarantee that he would play out all of his games, and see that they were correctly recorded, in which event this deposit would be refunded. Mr. I. O. H. Taylor offered a prize of $10 for the most brilliant game of the tournament, which trophy was won by the Rev. Mr. Skipworth.

The following were the scores of the players:

Mr. F. S. Ensor, of Nottingham, 5½ games, First Prize.
Mr. Thorold, 5 games, Second Prize.
Rev. A. C. Rowley, 3½ games, Third Prize.
Rev. C. E. Ranken, 3 games.
Rev. A. P. Skipworth, 2 games.
Rev. J. Coker, 2 games.
Dr. Eaton, 0 games.

We select one of the games between the victor and Rev. J. Coker.

A second tournament was also inaugurated for players of not sufficient strength to compete with the first class players. Additional interest was given to this contest by the entrance of Miss Rudge, who, as seen by the following score, carried off the third prize:

First Prize, Mr. Marriott. 8 games.
Second Prize, Mr. Newham. 7 games.
Third Prize, Miss Rudge. 5½ games.

A third tournament was held in which only local players participated, Mr. Paget winning first prize, Messrs. Symons and Gibson tieing for a second and third.

A Handicap Tournament was held in which players were equalized by the giving of odds. Mr. Ranken won the first prize, £5, Mr. Thorold the second.

A tournament was then held in which the pieces were displaced at the commencement of the game, so as to throw a player upon his own resources, and render his book knowledge of but little value. Mr. Ensor's skill was again demonstrated by his carrying off the first prize, 5 guineas, Messrs. Newham, Ranken and Skipworth tieing for the others.

THE New Association Problem Tournament is beginning to attract the attention that it deserves. Already some dozen entries have appeared in the different chess departments, and our critics are speculating upon the probabilities. A complete collection of the problems, so far as published, appears in the opening number of the *American Chess Journal*.

The Cleveland *Voice* publishes a long list of new subscribers to the American Chess and Problem Association; we regret that our space will not allow us to do the same, but we take this opportunity of reminding our readers that this association was formed for the purpose of promoting the cause of chess, and that the entire amount of subscriptions are offered in annual prizes. The amount of the prizes of the present Problem Tournament, as well as the proposed Playing Tournament, will depend upon the number of members who join the association. As the annual fee is only one dollar, which will entitle each member to due notice of all important matters connected with the association, we trust that all will forward their names to the Treasurer, Dr. C. C. Moore, No. 68 Cortlandt street, remembering at the time that subscribers have the right to say to which Tournament—the game or problem—they wish to have their contribution given. All subscriptions should be sent in before the 31st of March, as the Tournament closes at that date.

P. T. DUFFY.

LINCOLN COUNTY CHESS ASSOCIATION TOURNEY.

Scotch Gambit.

REV. J. COKER.	MR. F. S. ENSOR.
WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. P to Q 4	3. P x P
4. Kt x P	4. Kt x Kt
5. Q x Kt	5. P to Q 3
6. B to Q B 4	6. Kt to K B 3
7. Kt to Q B 3	7. B to K 2
8. Castles.	8. Castles.
9. K to R sq	9. R to K sq
10. P to K B 4	10. P to Q Kt 3
11. P to K B 5	11. B to Q Kt 2
12. B to Q Kt 3	12. Kt to K Kt 5
13. P to K R 3	13. B to K B 3
14. Q to Q 3	14. B x Kt
15. Q x B	15. Q to K R 5
16. K to Kt sq	16. Kt to K B 3
17. Q x Q B P	17. Q x K P
18. B x P ch	18. K to R sq
19. R to B 3	19. R to Q B sq
20. Q x Q P	20. R x Q B P
21. B to Q 3	21. K R to Q B sq
22. R to K sq	22. Q to K R 5
23. K R to K 3	23. Kt to K 5
24. Q to Q 7	24. Q to B 7 ch
25. K to R 2	25. R (B 7) to B 2
26. Q to Q 3	26. R x B
27. R x Kt	27. B x R
28. R x B	28. Q R to K B sq
29. R to K B 4	29. Q to Q B 4
30. B to Kt 4	30. Q to B 3
31. B to Q 6	31. R to Q sq
32. B x Q	32. R x Q
33. B to Kt 8	33. R to Q 4
34. K to Kt 3	34. R to Kt 3 and wins.

WE are not overpartial to chess poetry, but consider the following as worth preserving:

THE CONTRAST.

The wise man thinks before he speaks,
And words of wisdom from him fall;
The fool speaks first, then haply thinks,
Or he may never think at all.

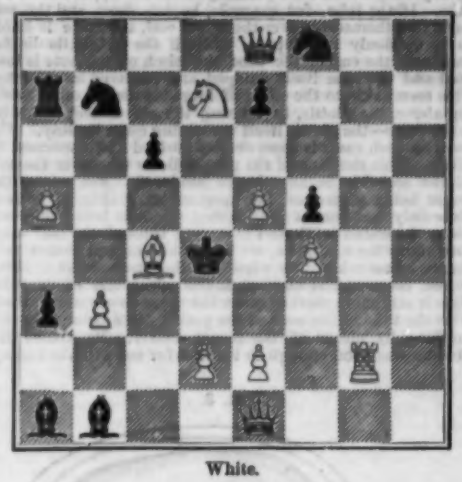
So in our royal game of Chess,
The rule of life is still the same;
Folly frets out its thoughtless hour,
And wisdom plays a cautious game.

[Tomlinson.

PROBLEM No. 63.—FIRST PRIZE.

BY J. BERGER.

Black.



White.

White to play and mate in four moves.

SOLUTIONS TO PROBLEMS.

No. 56.—By CHAS. A. GILBERG.

WHITE.	BLACK.
1. Kt to R 6	1. K x P
2. Q to K 4	2. P queens
3. Q to Q 5 mate.	
	1. K to B 3
2. Kt to Q B 5	2. P queens
3. Kt to Q 7 mate.	
	1. P queens
2. Q to B 5 ch	2. K to Q 5
3. Q to Q B 5 mate.	
	1. P x P
2. B to Kt 8	2. P queens
3. Q to Kt 7 mate.	

No. 57.—By CHAS. A. GILBERG.

WHITE.	BLACK.
1. Q to K B sq	1. K x Kt dis ch
2. Q to B 5 mate.	

LETTER "R."—ASSOCIATION TOURNEY.

WHITE.	BLACK.
1. Kt x R	1. K x Kt
2. R to Q B 7	2. B x P
3. P to B 5 ch	3. K to Q 3
4. Q to Kt 3 mate	
	2. K to Q 3
3. Q to Q B sq	3. Moves
4. Q to B 6 mate.	
	1. K to Q or K 2
2. R to B 7 +	2. K moves
3. Q to Q B sq	3. Moves
4. Q mates.	

ENIGMA No. 24.—By F. M. TEED.

WHITE.	BLACK.
1. Q to Q R 8	1. Any move
2. Mates accordingly.	

THE ODDS OF QUEEN'S KNIGHT.

MISS RUDGE, who received the third prize in one of the Lincolnshire Tournaments, is looked upon by many as the strongest lady chess player in England, having carried off the honors in several matches with leading players. Mr. Thorold has been defeated three matches in which he gave the odds of queen's knight. The following game we select from these matches as a specimen of Miss Rudge's chess play:

(Remove white Q Kt.)

MR. THOROLD.	MISS M. RUDGE.
WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. P to Q 4	2. P x P
3. Kt to K B 3	3. B to B 4
4. B to Q B 4	4. P to Q 3
5. P to Q B 3	5. P to Q 6
6. Q to Kt 3	6. Q to B 3
7. B to K Kt 5	7. Q to Kt 3
8. Castles (Q R)	8. P to K R 3
9. B to R 4	9. Kt to Q B 3
10. R x P	10. R to Q Kt sq
11. R to K sq	11. B to K 3
12. P to K 5	12. P to Q 4
13. B x P	13. K Kt to K 2
14. P to B 4	14. B to B 4
15. B x K Kt	15. B x B
16. B x Kt ch	16. Q x B
17. Kt to Q 4	17. Q to K Kt 3
18. Kt x B	18. Q x Kt
19. P to Kt 3	19. Q x B P
20. Q to Q sq	20. B to Kt 4 ch
21. K to Kt sq	21. Q to K B 4
22. K to R sq	22. Castles.
23. R to K B 3	23. Q to K 3
24. P to K R 4	24. B to K 2
25. R to B 4	25. Q R to Q sq
26. Q to B 2	26. B to B 4
27. Q to B 3	27. Q to Q 2
28. Q to K B 3	28. Q to Q 7
29. Q to K B 3	29. Q to Q 6
30. Q to B sq	30. K R to Q sq, and wins in a few more moves.